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ABSTRACT

The document is based on a premise that mid-twentieth century experience with income distribution cannot be adequately understood without a better knowledge of the long-term macroeconomic forces that have endogenously determined the wage structure. The secular performance of the price of skills and the occupational wage structure are important to an understanding of technique choice, labor-saving technological change, capital formation, and income distribution. A quantitative documentation and an analysis of related literature on the relative price of raw labor, skills, and machines during the period 1816-1896 are presented with illustrative tables and discussion. An attempt is made to redress the balance from labor supply to demand explanations of the long and short-term behavior of wage differentials in the nineteenth century and compare this with the twentieth century experience. (Author/EC)

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THE RELATIVE COSTS OF AMERICAN MEN, SKILLS, AND MACHINES: A LONG VIEW

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ABSTRACT

The premise of this paper is that mid-twentieth-century experience with income distribution cannot be adequately understood until we have a better understanding of the long-term macroeconomic forces that have endogenously determined the American wage structure. While such an undertaking will require sophisticated general equilibrium analysis and a careful bridging to the size distribution, surely a first step must be an improved documentation of the behavior of the structure of factor rents over America's long-term growth experience. This paper supplies this quantitative documentation. Future efforts will be devoted to a careful theoretical rationalization of these economic events with the hope that an improved theory of income distribution will eventually emerge.

THE RELATIVE COSTS OF AMERICAN MEN, SKILLS, AND MACHINES: A LONG VIEW

I. Introduction

Shortly before World War I, the premium on skilled labor was extraordinarily high in America. Skills were very expensive even by Western European standards. Phelps-Brown notes that the ratio of skilled to unskilled wages in American building trades, for example, was 2.17 in 1909. Just two years earlier, the ratio was as low as 1.54 in the United Kingdom.[1] The relative price of American skills was not always so high, nor was the distribution of earnings so unequal. Indeed, a century earlier, English visitors characterized America as a nation endowed with cheap skills and expensive "raw" labor. While Habakkuk supplied extensive contemporary comment on the abundance of skilled labor in America during the 1820s,[2] Rosenberg gave the characterization quantitative muscle. Unskilled wages were at least 20 percent higher in America than in England in the 1820s. Yet, Rosenberg's wage data for "best machine makers" and "ordinary machine makers" reveal very little difference between the two economies.[3] In short, compared to England, skilled labor was relatively cheap in America at the start of modern industrialization. This is a finding of some note since the conventional view seems to be that common labor is plentiful and skilled labor rare at early stages of industrialization.[4] Certainly contemporary developing nations--with gross inequality, surplus labor, a dearth of skills, and enormous wage premiums--would seem to support this view. A century later, conditions had reversed and skilled labor was relatively expensive in America.

Once again a striking fact, since conventional wisdom has it that formal education and on-the-job training should gradually make "skilled labor plentiful and reduce the premium which skilled labor receives in the early stages of industrialization."[5]

What explains this reversal in the American wage structure? Was it a gradual, steady, and cumulative process over the century, a process endogenous to America's growing economic system? Did, instead, some revolutionary exogenous shocks make themselves felt somewhere during the century? If the skill premium was rising to high levels, why didn't indigenous labor supply forces drive these quasi-rents to skills back down the way modern human capital models tell us they should have? As is often the case in his extraordinary book, Habakkuk supplies a ready answer to all of these questions. In the 1820s and 1830s,

> There was much more international mobility of skilled than of general labour, and a high proportion of English migrants to the U.S.A. before the start of mass migration were skilled workers.
>
> In the early decades of the century therefore immigration did more to alleviate the shortages of artisan skills than of unskilled labour.[6]

As the antebellum era wore on, however, the character of immigration changed:

> With the passage of time changes occurred in the conditions of labour-supply in America... the start of heavy immigration in the 1840's and '50's... reduced the disparity between the inelasticity of labour-supply between the two countries...."[7]

And what happened to the relative price of skills as a consequence? By the late 1860s "the premium on skill was higher in America than in England."[8] Habakkuk's position seems to be shared by many economic historians. That is, the position that skilled-wage differentials remained

stable at low levels through the early 1840s; that they rose dramatically from the mid-1840s to the Civil War Reconstruction period; that the rise is explained by changing labor supply elasticities by skill; and that the shifting labor supply elasticities by skill are explained by the massive immigration of unskilled labor inaugurated by the Irish in the late 1840s and 1850s.

The secular performance of the price of skills and the occupational wage structure are obviously important to our understanding of technique choice, labor-saving technological change, capital formation, and income distribution in America. Yet the arguments summarized above are based on the slimmest data fragments. Indeed, Habakkuk had the honesty to describe his discussion as "conjectural" since at his writing there was "little readily available information about the... price of different types of labour."[9] This paper shall attempt to fill this gap and supply an index of the relative price of raw labor, skills, and machines over eight decades, 1816-1896. Having done so, we shall attempt to redress the balance from labor supply to <u>demand</u> explanations of the long- and short-term behavior of American wage differentials in the nineteenth century.

The end of the paper turns to more recent and familiar history. How did American experience with the wage structure and earnings inequality fare after the 1896 turning point? Did twentieth-century development induce a long-term secular erosion of the skill differential, an erosion apparently initiated during the mid-1870s? How do the twentieth-century "revolutions" in wage structure compare with nineteenth-century "epic" shifts?

II. The Relative Rental Prices of Men and Skills: 1816-1896

A. Zabler's Eastern Pennsylvania Iron Workers, 1816-1830

Both Zabler and Adams have constructed long time series on the occupational wage structure for the early nineteenth century. Zabler's study relies on manuscript payroll data for iron-producing firms in eastern Pennsylvania for the 1800-1830 period.[10] Adams utilizes manuscript data for Philadelphia construction and shipbuilding over the 1785-1830 period.[11] Our interest here is only with the implied secular movements in the wage structure over time, and for that purpose we prefer Zabler's series. In the ensuing debate between Adams and Zabler, it became apparent that the central issue for them was the absolute size of wage differentials in early nineteenth-century America and comparisons with England.[12] This is not our interest here, so our choice of Zabler's series is defended on other grounds.

Adams's Philadelphia skilled-wage differential seems to be somewhat atypical.[13] First, Figure 1 exhibits enormous short-run instability in the Philadelphia series. No such instability is revealed in Zabler's data. Apart from the readjustment immediately following the Embargo and War of 1812, it is difficult to imagine a preindustrial society exhibiting this much short-term volatility in wage structure except in an isolated labor market subjected to atypical shocks. Second, qualitative accounts tell us that the commercial crisis in 1816-1819 was of impressive magnitude.[14] In every "commercial crisis" after 1840 and up to the twentieth century, the relative price of skilled labor has stabilized or

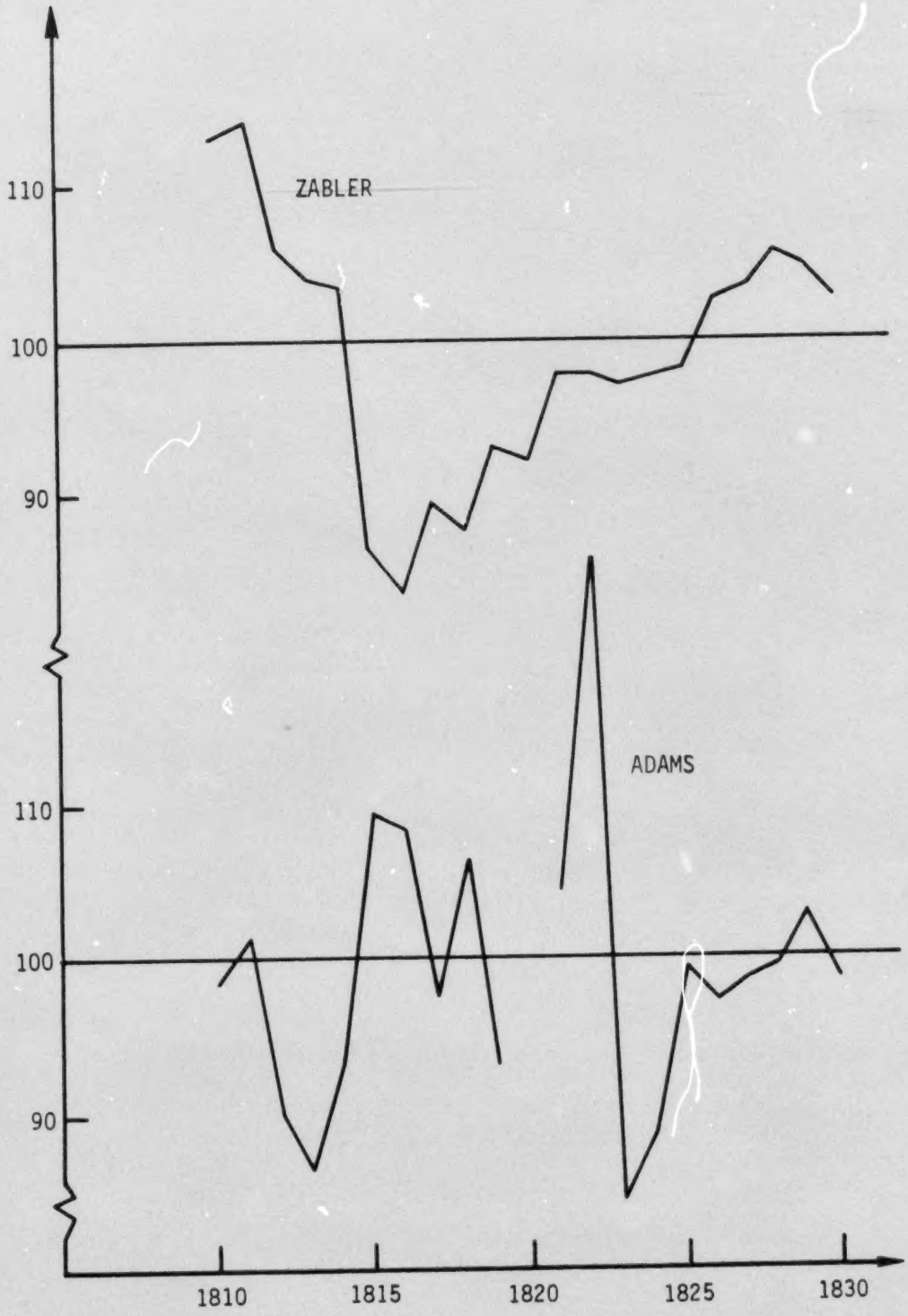


Figure 1. Two Indices of the Relative Price of Skilled Labor (1820-30 = 100), 1810-1830

fallen, since it is linked far more closely than unskilled labor to capital formation activity. While Zabler's data faithfully reflect the commercial crisis, Adams's Philadelphia series does not. Third, in the absence of massive immigration of skilled labor, early industrialization is normally thought to raise the relative price of skills as output mix shifts to favor skilled at the expense of unskilled labor. While Zabler's data reflect this pressure on the labor market from 1820 to 1830, Adams's data do not. Finally, the Aldrich Report documents for the 1850s wages for many of the same Philadelphia and eastern Pennsylvania occupations utilized by both Adams and Zabler. Taking the average ratio of skilled to unskilled wages equal to 100 in the 1820s, the index stands at 73.3 in the 1850s if Adams's Philadelphia occupations are used; the index stands at 128.6 when Zabler's eastern Pennsylvania iron occupations are used (Variant A, Table 2). As section II.B indicates, there is not a shred of evidence to confirm a decreasing skill differential from the 1820s to the 1850s. On the contrary, there is abundant evidence (and good common sense) confirming the eastern Pennsylvania prediction over these three crucial antebellum decades. Zabler's data are presented in Table 1 for 1816-1830.

B. The Upward Drift in Skilled-Wage Premiums: 1830-1860

Zabler's eastern Pennsylvania occupations are also documented in the Aldrich Report for the 1840s. Evidence on the 1830s is slim, but this section describes our procedures in linking the 1816-1830 and 1840-1850 periods. The basic difficulty encountered is that there is an incomplete intersection of occupations in the Aldrich and Zabler sources, and a smaller sample of Zabler's occupations must be utilized to form the link.

Table 1

Ratio of Skilled to Unskilled Wages, Eastern Pennsylvania Iron Industry, 1816-1830 (percent)

Year	W_s/W	Year	W_s/W
1816	95.4	1823	110.8
1817	102.5	1824	111.4
1818	100.2	1825	112.2
1819	106.2	1826	116.9
1820	105.2	1827	118.1
1821	111.4	1828	120.4
1822	111.6	1829	119.3
		1830	117.3

Source: Zabler, "Further Evidence," Table 3, Col. B, p. 114. Skilled occupations (unweighted average) include clerks, furnace keepers, carpenters, smiths, millers, and colliers. Unskilled occupations (unweighted average) include furnace fillers, laborers, teamsters, woodcutters, and banksmen.

Table 2 and Figure 2 present three variants of a skilled-wage ratio based on eastern Pennsylvania iron industry occupations. Fortunately, their secular movements and cycles are almost identical. Each variant uses the identical unweighted average of furnace fillers, laborers, and teamsters in constructing the unskilled-wage rate. The skilled wage is an unweighted average of various combinations of more prestigious occupations in the industry. Although Variant A is the most limited occupational sample, it does have the undisputed advantage of covering the 1840s. In addition, it replicates the other two variants in the 1850s. Each of these eastern Pennsylvania iron industry variants conforms almost exactly with the economy-wide indices forthcoming from the Aldrich Report.

According to Variant A in Table 2, the ratio of skilled to unskilled wages rises from an index of 114.7 in 1820-1830 to 147.5 in 1850-1860. Nothing like this surge in skilled wages relative to unskilled wages occurs for the rest of the century, including the post-Civil War "catching up" decade. Apparently, the surge is equally distributed between the 1830s and 1840s, but the most striking rise is centered on the late forties.

We have only the sketchiest data for the 1830s, but none of it is inconsistent with the upward drift in the relative price of skilled labor documented in Figure 2. Indeed, we may have understated the extent of the rise. For example, when Layer computed daily earnings of cotton mill employees by department,[15] he found that the dressing department was consistently the highest paid in the antebellum period, while spinners (mostly female) were the lowest. The pay differential rose by 13 percent from 1830-1834 to 1840-1844. Over the same period, our index rises by 9 percent.

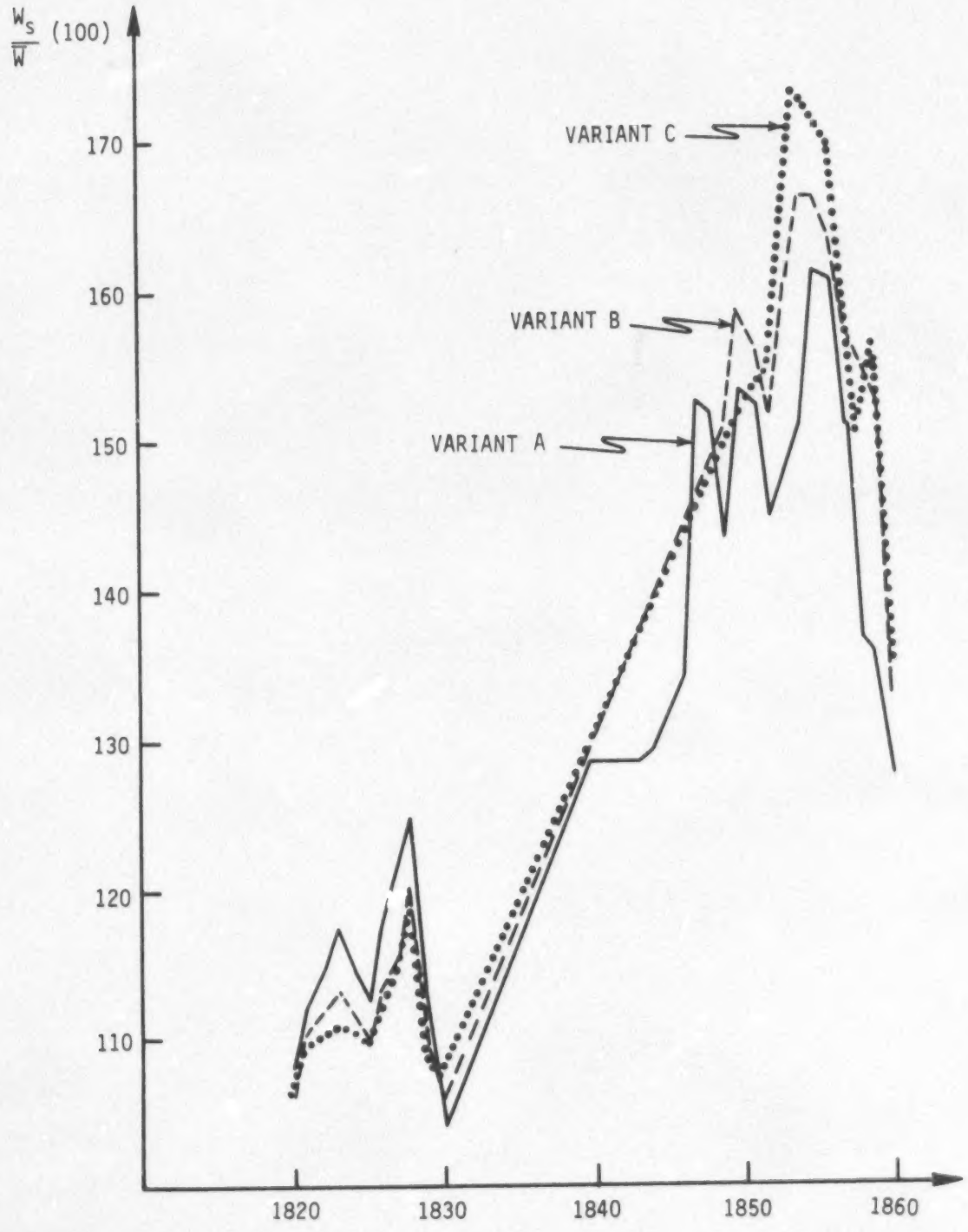


Figure 2. Three Variants of the Relative Price of Skilled Labor, 1820-1860 (Zabler-Aldrich)

Table 2

Skilled-Wage Ratio, Three Variants, Based on Eastern Pennsylvania Iron Industry, 1820-1860
(percent)

Year	Variant A	Variant B	Variant C
1820	108.0	107.6	107.5
1821	112.2	110.5	109.6
1822	114.8	111.8	110.1
1823	117.3	113.1	110.6
1824	114.9	111.5	110.9
1825	112.5	109.9	109.7
1826	117.9	113.6	112.4
1827	121.6	116.0	114.2
1828	124.9	120.0	118.6
1829	113.4	109.7	108.9
1830	104.0	105.2	105.8
1840	128.4		
1841	128.4		
1842	128.4		
1843	128.4		
1844	129.5		
1845	131.7		
1846	134.0		
1847	152.9		
1848	151.9		
1849	143.4	150.5	
1850	153.5	158.4	
1851	152.4	156.3	153.7
1852	144.7	151.5	154.9
1853	147.2	160.4	165.4
1854	151.3	166.0	173.1
1855	161.3	166.0	171.5
1856	160.7	163.6	169.2
1857	150.9	157.9	162.1
1858	136.8	143.6	150.4
1859	135.8	152.5	156.3
1860	127.7	132.6	135.0

Sources: 1820-1830 data from Zabler, "Further Evidence," Tables 1 and 2, pp. 112-113, based on eastern Pennsylvania iron industry occupations. Unskilled wages are the average of furnace fillers, laborers, and teamsters. Skilled wages are the

Sources: (continued)

average of the following:

Variant A - keepers and carpenters;
Variant B - keepers, carpenters, and smiths;
Variant C - keepers, carpenters, smiths, and millwrights.

The 1840-1860 data use the same occupations and are drawn from the Aldrich Report as reproduced in U.S. Department of Labor, Bureau of Labor Statistics, History of Wages in the United States from Colonial Times to 1928, Bulletin No. 604 (Washington: GPO, 1934), pp. 159-160, 247-248, 250, 253-254, 275, 308, and 448.

More detailed confirmation of our characterization of the 1830s can be found from Erie Canal payrolls and civil engineer earnings on internal improvement projects. The relevant data are presented in Table 3. Between 1830 and 1845, the rise in the skilled-wage premium paid on the Erie Canal very closely replicates that of the Zabler-Aldrich Pennsylvania index. While the latter rose by 14.2 percent over the fifteen years, the two canal indices rose by 15.0 and 13.9 percent. Granted, the civil engineer index is more relevant than the teamworker index, but the latter supplies annual observations and it also--with the exception of the 1840 depression year--closely corresponds to the civil engineer index. We shall in fact use column (1) in Table 3 to interpolate annual observations for the 1831-1839 Zabler-Aldrich series.

While we encountered no difficulty in confirming a surge in pay differentials during the 1830s, how about the 1840s? Do other wage indicators confirm the epic spreading in pay differentials during the 1840s? Apparently so, since other data fragments in the Aldrich Report suggest:

New York Building Trades. Compared with common laborers, the daily rate for bricklayers rose by 18 percent from 1840 to 1850, while that of carpenters and joiners rose by 37 percent over the same period. If the remainder of the nineteenth century is to be a guide, skill premiums tend to collapse during protracted depressions. Since 1840 was a depression year (although not yet the nadir of the forties), these rates of change may have an upward bias.

New York Metal Trades. These exhibit comparable upward drift. Compared to common laborers, blacksmiths' daily wage relatives rose by 13 percent over the decade while "best" machinists' relatives increased by

Table 3

Skilled-Wage Ratios Based on Erie Canal and Other Internal Improvement Projects Payrolls, 1830-1845 (1830=100)

Year	(1) Teamworkers / Common Labor	(2) Average Civil Engineers / Common Labor	(3) Zabler-Aldrich Index
1830	100.0	100.0	100.0
1831	105.0	-	-
1832	105.0	-	-
1833	110.0	-	-
1834	115.0	-	-
1835	113.4	109.9	-
1836	112.5	-	-
1837	106.1	-	-
1838	105.2	-	-
1839	107.6	-	-
1840	112.9	94.2	111.3
1841	121.3	-	111.3
1842	116.0	-	111.3
1843	117.0	-	111.3
1844	110.0	-	112.3
1845	115.0	113.9	114.2

Sources: Column (1) is taken from W. B. Smith, "Wage Rates on the Erie Canal," Journal of Economic History 23 (September 1963), Table 1, pp. 303-304. Both series are nominal daily wages paid on the Erie Canal. Column (2) uses Professor Smith's Erie Canal daily wage of common labor in the denominator. The numerator is a weighted average of annual earnings of all civil engineers, regardless of rank, working on canals and other internal improvements. M. Aldrich, "Earnings of American Civil Engineers, 1820-59," Journal of Economic History 31 (June 1971), Table 1, p. 201. Column (3) is taken from Table 6 below.

37 percent. From 1843-1844 to 1850, boilermakers' wage relatives increased by 8 percent and those of iron molders by 13 percent.

Massachusetts Cotton Textiles. The Aldrich Report data for the 1840s are inadequate, but we note that from 1848 to 1860, loom fixers' wages rose by 37 percent relative to those of speeder-tenders.

Massachusetts Transportation. The ratio of railroad conductors' wages to those of common labor rose by 10 percent in the 1840s. Relative to teamsters' wages, they rose by 14 percent. Similar results are found for railroad engineers.

We have dwelt at length on the 1830s and 1840s since measures of the changing wage structure during these decades of early industrialization are likely to be crucial to economic interpretations of antebellum growth. It seems appropriate, therefore, to conclude this section by examining some Massachusetts wage data directly relevant to the "dear labor" debate. Rosenberg's use of Zachariah Allen's data confirmed that in 1825 the average British machinist was paid a premium above common labor of some 105 percent while his American counterpart earned only a 50 percent premium--cheap skills and expensive "raw" labor in America. Table 4 traces out New England experience with this classic skilled-wage premium to 1883.[16]

Table 4

Ratio of Machinist's Daily Wage to That of Common Labor (percent)

Year or Period Ending	Massachusetts	England
1825	150.0	205.4
1831-1840	154.8	
1837	185.2	
1845	169.0	
1841-1850	190.1	
1851-1860	220.5	
1871-1880	168.2	
1881-1883	171.8	

The late 1830s did indeed mark a surge in the premium, which reached 85 percent by the panic year of 1837. The second surge in the late 1840s is also apparent, so that the wage ratio index averaged 220.5 from 1851 to 1860. That is, urban Massachusetts's wage structure in the 1850s was almost exactly like England's in 1825, and it never again reached that height in the three decades that followed.

C. The Antebellum Plateau: Aldrich, 1850-1860

Now that we have linked Zabler's 1816-1830 series with the 1840-1860 period, we can rely on the more abundant data in the Aldrich Report to construct a superior wage structure index for the 1850s. The index relies on the daily wage quotations (January) in the Aldrich Report for the following regional industries, which offer the greatest detail over the decade as a whole: Massachusetts metals, Massachusetts cotton textiles, New York metals, New York illuminating gas, Connecticut stone quarrying, New Hampshire metals, and Rhode Island woolen goods. The relative skilled-wage ratio reported in Table 5 is derived by using employment census weights for 1840 and 1850 with linear interpolation for intervening years. For comparison, Variant A based on Zabler's eastern Pennsylvania iron industry occupations is also presented.

The resulting Aldrich skilled-wage relative series closely conforms with our notions regarding the behavior of the wage structure over "cycles." The index rises to a peak in 1855-1856 before undergoing a secular decline up to the Civil War. The magnitude of the decline 1857-1860 is striking, however. As we shall see in the next section, the peak of the plateau reached in the mid-fifties is not again attained until the end of the post-Civil War "catching up."

Table 5

Skilled-Wage Ratio, Aldrich and
Variant A, 1850-1860
(percent)

Year	Aldrich Report		Variant A	
	(1) Actual	(2) 1850=100	(3) Actual	(4) 1850=100
1850	180.8	100.0	153.5	100.0
1851	183.6	101.5	152.4	99.3
1852	181.1	100.2	144.7	94.3
1853	180.7	100.0	147.2	95.9
1854	184.3	101.9	151.3	98.6
1855	185.5	102.6	161.3	105.1
1856	191.3	105.8	160.7	104.7
1857	174.9	96.7	150.9	98.3
1858	169.8	93.9	136.8	89.1
1859	173.8	96.1	135.8	88.5
1860	173.7	96.1	127.7	83.2

Sources: Column (1) is taken from the Aldrich Report and is a weighted average using census employment weights. See text. Column (3) is taken directly from Table 2, Column (1).

D. The Civil War, Postwar "Catching Up," and Retardation: Aldrich-Long-BLS, 1860-1896

For the period up to 1890, we rely on Clarence Long's computations from the Aldrich Report.[17] While the Aldrich Report included some 500 continuous series of occupational wage quotations from the payrolls of 78 firms, Long restricts his calculations to 49 establishments in 13 manufacturing industries and 21 building trades. He omits clerical, managerial, and pieceworkers from his series, and covers only the New England and Middle Atlantic states. The data are weighted by employment. With only minor adjustments, Table 6A uses the Aldrich-Long index, while the series is extended to 1896 (Table 6B) using Wright's BLS data.

The Aldrich-Long (adjusted) series shall be used throughout our analysis. Note that its behavior (Figure 3) is consistent with what we know about the determinants of occupational wage structures. A modest decline in the skill premium was recorded during the Civil War (1862-1865), a result forthcoming from American experience in twentieth-century World Wars as well. It reflects a contraction in capital formation and service activities in favor of agriculture and manufacturing industries, which were relatively intensive in unskilled labor.[18] These conditions were reversed with the war's end, and thus the decade 1865-1874 produced a postwar surge and "catching up" in the wage structure. The 1874 skill premium finally regained the very high levels achieved in 1855-1856, and barely exceeded the 1862 level. The depression of the seventies induced a decline in the skill premium while the boom of the eighties produced a partial recovery, cycles apparent in twentieth-century experience as well. More interesting, perhaps, is the longer-term

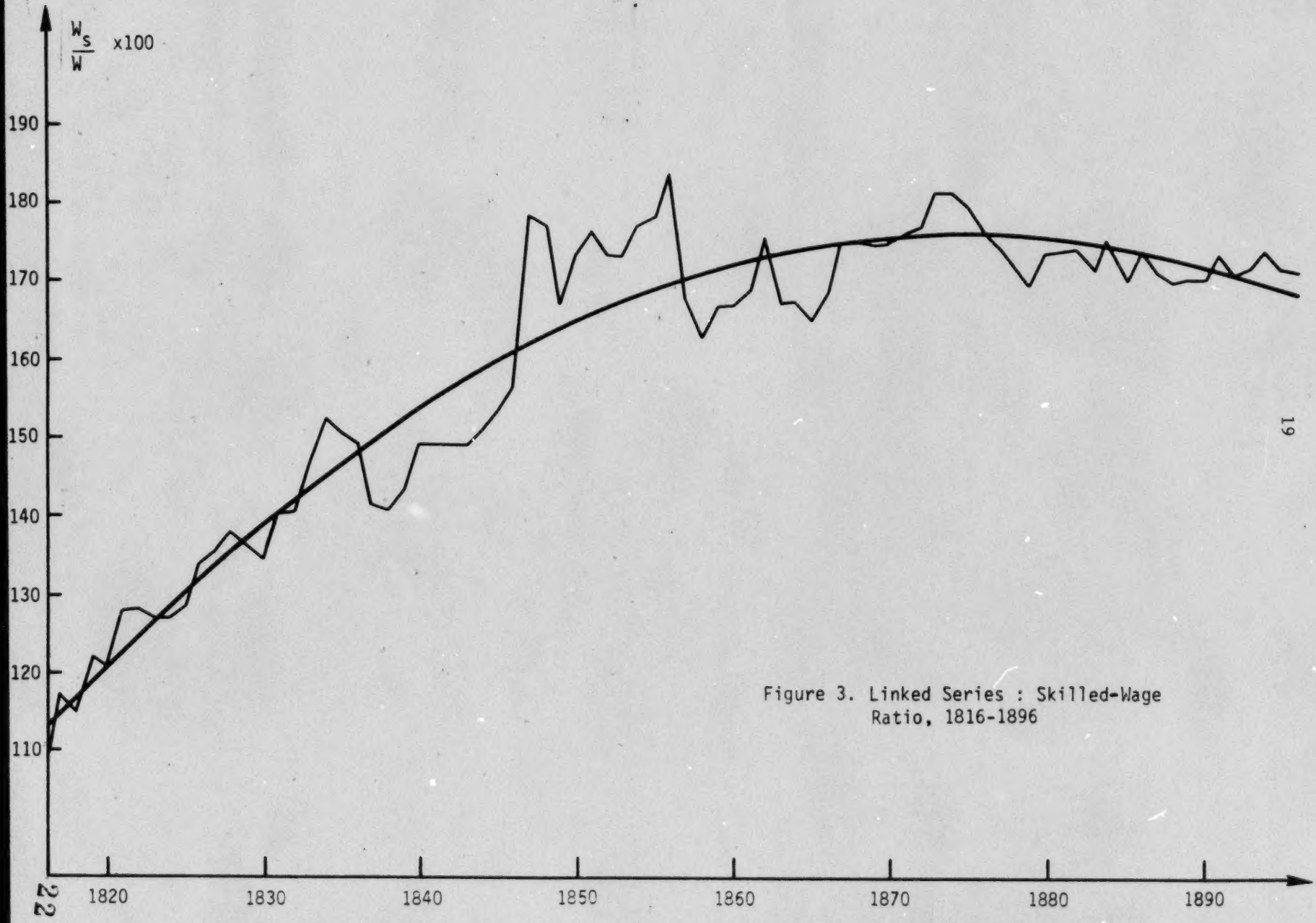


Figure 3. Linked Series : Skilled-Wage Ratio, 1816-1896

Table 6A

Skilled-Wage Ratio, 1860-1890
(percent)

Year	Aldrich-Long	
	(1) January	(2) Adjusted
1860	167.3	166.8
1861	168.0	168.6
1862	174.2	175.8
1863	163.1	167.6
1864	156.9	167.7
1865	164.9	165.2
1866	166.4	168.4
1867	173.2	174.9
1868	175.3	175.3
1869	173.7	174.4
1870	174.4	175.4
1871	176.4	176.1
1872	174.8	177.4
1873	179.9	181.2
1874	181.0	181.0
1875	180.5	179.6
1876	179.9	176.2
1877	176.1	174.0
1878	175.9	174.5
1879	171.9	169.7
1880	170.4	173.4
1881	172.1	173.6
1882	172.7	174.1
1883	170.7	171.4
1884	174.7	174.7
1885	170.3	170.3
1886	170.8	172.6
1887	170.5	170.5
1888	170.0	169.7
1889	169.3	170.0
1890	170.2	170.2

Source: Column (1) computed from Long, Wages and Earnings in the United States, Appendix Tables A-5 and A-6, pp. 143-144. The "adjusted" series in column (2) is simply the average of January and July.

Table 6B

Skilled-Wage Ratio, 1890-1896
(percent)

Year	(1) BLS	(2) Year	(3) BLS
1890	170.2	1894	173.5
1891	173.2	1895	171.8
1892	170.6	1896	171.7
1893	171.7		

Source: C. D. Wright, "Wages and Hours of Labor," Nineteenth Annual Report of the Commissioner of Labor (1904), Table IIIC. The Wright-BLS series is linked to the Aldrich-Long series in Table 6A, column (2), where 1890 = 170.2. The Wright-BLS series is calculated as an unweighted average of skilled ratios in building trades and ten manufacturing industries: brick, flour, foundry and machine shops, glass, iron and steel bar, iron and steel open hearth, lumber, marble and stone, planing mills, and printing and publishing.

gentle decline in the skill premium from the mid-seventies to 1896. This trend parallels the decline in (physical) capital stock growth rates, a retardation in output per capita growth, and declining secular profit and interest rates.[19]

E. The Broad View: A Combined Index, 1816-1896

Table 7 pulls all this information together into a continuous series from 1816 to 1896. It is also reproduced in Figure 3. How do Habakkuk's "conjectures" measure up to the quantitative record? Indeed, how does de Tocqueville's somber alarm measure up?

> I am of the opinion...that the manufacturing aristocracy which is growing up under our eyes is one of the harshest that ever existed in the world...the friends of democracy should keep their eyes anxiously fixed in this direction; for if ever a permanent inequality of conditions and aristocracy again penetrates into the world, it may be predicted that this is the gate by which they will enter.[20]

What is most remarkable about the series is the striking surge in the relative price of skills from 1816 to 1856. The movements in the series after 1856 pale by comparison. In four short decades, rapid industrialization and structural change in the American Northeast transformed the economy from one of relatively cheap skilled labor to one more typical of developing economies with very wide pay differentials, scarce skills, and, presumably, marked inequality in the distribution of wage income. Marrin Bronfenbrenner describes this "new American tradition" in his typically caustic language:

> The United States developed...a tradition of high skill differentials for its labor aristocracy... in contrast with "greenhorns" from overseas, "hicks" and "hillbillies" from the countryside, and "niggers" from the South.[21]

Table 7

Skilled-Wage Ratio, 1816-1896: A Linked Series
(percent)

Year	Linked Series	Residual	Year	Linked Series	Residual	Year	Linked Series	Residual	Year	Linked Series	Residual
1816	109.4	-3.5	1840	149.8	-4.0	1865	165.2	-8.9	1891	173.2	2.1
1817	117.6	2.6	1841	149.8	-5.3	1866	168.4	-6.1	1892	170.6	.1
1818	114.9	-2.2	1842	149.8	-6.5	1867	174.9	.1	1893	171.7	1.9
1819	121.8	2.6	1843	149.8	-7.7	1868	175.3	.3	1894	173.5	4.4
1820	120.7	- .5	1844	151.1	-7.5	1869	174.4	- .9	1895	171.8	3.4
1821	127.8	4.6	1845	153.7	-6.0	1870	175.4	- .1	1896	171.7	4.0
1822	128.0	2.9	1846	156.4	-4.4	1871	176.1	.5			
1823	127.1	.1	1847	178.4	16.6	1872	177.4	1.7			
1824	127.8	-1.1	1848	177.3	14.5	1873	181.2	5.4			
1825	128.7	-2.0	1849	167.3	3.5	1874	181.0	5.1			
1826	134.1	1.6	1850	173.6	8.9	1875	179.6	3.7			
1827	135.5	1.2	1851	176.2	10.6	1876	176.2	.4			
1828	138.1	2.1	1852	173.8	7.4	1877	174.0	-1.8			
1829	136.8	- .9	1853	173.5	6.3	1878	174.5	-1.2			
1830	134.6	-4.7	1854	176.9	8.9	1879	169.7	-5.8			
1831	140.5	- .4	1855	178.1	9.4	1880	173.4	-2.0			
1832	140.5	-2.0	1856	183.6	14.1	1881	173.6	-1.6			
1833	146.4	2.3	1857	167.9	-2.2	1882	174.1	- .8			
1834	152.3	6.7	1858	163.0	-7.7	1883	171.4	-3.2			
1835	150.4	3.4	1859	166.8	-4.5	1884	174.7	.4			
1836	149.3	.8	1860	166.8	-5.1	1885	170.3	-3.7			
1837	141.8	-8.1	1361	168.6	-3.8	1886	172.6	-1.0			
1838	140.7	-10.5	1862	175.8	2.9	1887	170.5	-2.7			
1839	143.6	-8.9	1863	167.6	-5.7	1888	169.7	-3.0			
			1864	167.7	-6.0	1889	170.0	-2.2			
						1890	170.2	-1.5			

Sources: 1860-1896, Table 6A, Column (2) and Table 6B; 1850-1860, Table 4, Column (1), linked at 1860 values. 1840-1849, Table 2, Column (1), linked at average 1850-1854 values. 1816-1830, Table 1 linked at average 1826-1830 values for variant A, Table 2, and Zabler, Table 1. 1831-1839, interpolated values based on Table 3, Column (1). The regression reported in the text is

Sources: (continued)

$$SWR(t) = -63865.2 + 68.3183t - 0.0182t^2, \ \bar{R}^2 = .918,$$
$$\qquad\qquad (14.8) \quad (14.6871) \ (14.5401)$$

where the figures in parentheses are t-ratios. Needless to say, these results are statistically signaificant. The "residuals" report differences between the actual annual linked series observations and predicted values from the estimated equation above.

The tradition is certainly long and persistent; we shall find below that there is no evidence of a really significant diminution in the skill differential until after the 1920s. The important point, however, is that it required modern industrialization from above to produce the labor aristocracy, although the exogenous inflow of "unwashed and unskilled" Europeans certainly reinforced the process from below.

Habakkuk disagrees. He accounts for this "revolutionary" change in wage structure by appealing to the composition and volume of international migration. He argues that the immigration prior to the late 1840s was relatively skilled, while the mass immigrations--especially from Ireland--following 1845-1846 were heavily unskilled. No doubt this accounting of immigration's impact is correct, but surely we must search for other systematic forces producing these secular trends in pay differentials. After all, this "Kuznetsian inverted U" seems to be typical of so many economic histories, whether of immigrant receiving regions, emigrant sending nations, or contemporary closed Third World societies. Changing labor supply conditions simply cannot be expected to carry the full weight of the explanation.

Figure 3 and Table 7 seem to add further doubts to any monocausal immigration-labor supply thesis. Granted, the increase in the skill premium between 1846 and 1848 is without precedent even in boom periods, and it coincides with an equally unprecedented surge in immigration. Yet long swings, cycles, and exogenous demographic events should not blind us to an even more remarkable long-term trend that starts very early in the century. From 1816 to 1856, the secular rise in the skilled-wage ratio was significantly interrupted only once--after

1837 and deep into the doldrums of the early forties. Indeed, the two decades following 1816 contain the most dramatic long-term surge in the skilled-wage ratio during all of the nineteenth century. Furthermore, the experience of the 1820s and 1830s conforms very well to the curvilinear trend estimated and reported in Table 7. This trend line suggests that the skilled-wage ratio reached its long-term peak in 1875, almost coincident with the actual short-run cyclic peak in 1873-1874. This is not to deny the manifest existence of long swings and cycles in U.S. antebellum growth! Indeed, even after the secular trend is removed, there remains a uniquely large rise in the skilled-wage ratio following 1846. Short-run immigration experience always had a profound influence on labor markets and income distribution in American economic history. The larger issues raised in this paper, however, deal with the long term. In this regard, how do we reconcile the evidence of sharply rising wage differentials prior to the 1840s with the fact that immigration was a relatively small source of labor force expansion over the same period?[22] Indeed, a similar problem of reconciliation appears in the last quarter of the century (up to 1896, at least) when the relative importance of unskilled immigration <u>increased</u> while the skill differential, if anything, declined.

It seems more appropriate to characterize long-term nineteenth-century trends as following a steady rise in the skill premium up to the 1870s and a slow but perceptible decline thereafter to 1896. Furthermore, it seems likely that disequilibrating demand forces are responsible for this trend in wage structure and wage income distribution.[23] True, the surge in the skill premium would have been less pronounced in the 1850s had not unskilled immigrants flooded the American labor market from 1846

onwards. But we can find no support for Habakkuk's casual rejection of the importance of demand forces:

> ...a plausible case can be made for supposing that in the early nineteenth century in the U.S.A. an increased demand for labour raised the wages of skilled labour less than the wages of unskilled labour....[24]
>
> In the U.S.A. when demand for labour rose, the labour-costs of machine-makers rose less than the labour-costs of the machine-users....[25]

On the contrary, throughout the period 1816 to 1856 and even to the 1870s, the main changes in output mix (especially in the Northeast) were the relative demise of agriculture and the expansion of capital formation activities. Furthermore, some of this output-mix change was induced by explicit policy choices. We know, of course, that agriculture was very unskilled-labor-intensive in the nineteenth century. Thus, the pronounced shift in America's output mix in general, and the Northeast's in particular, was to increasingly favor the relative demand for skills. Only when the share of new capital formation in GNP stabilized and when the rate of "industrialization" slowed down, all after the 1870s,[26] did the skilled-wage premium begin to decline. Furthermore, only by appealing to postbellum demand forces such as these can we reconcile the slight downward drift in the skilled-wage differential, since the monocausal immigration-labor supply thesis surely fails for the "Great Depression" (1873-1896). Easterlin's data show that the relative contribution of (unskilled) immigration to labor force expansion increased from 1870 to 1890 and to 1910. Indeed, the contribution of immigration to labor force expansion was higher in the 1880s than in the 1850s![27]

What is true of secular trends is also true of cycles. We can find no support for Habakkuk's assertion that

> ...in America, during a boom, the supply of machine-makers [skilled labour] was more elastic than the supply of unskilled labour...that is, the supply of machines was more elastic than the supply of [unskilled] labour....[28]

On the contrary, the depression of the late thirties reflects a relatively slack demand for skills, as do the slumps following 1856 and 1873. The "booms" of the early thirties, the late forties and the early fifties, and the "catching up" from Appomattox to the Panic of 1873 all reflect the relative expansion of the demand for skills. True, these "booms" also coincide with large inflows of unskilled Europeans, and real unskilled wages would have been higher in the absence of the immigration, but there is certainly no evidence that these surges in immigration actually reduced real unskilled wages. On the contrary, these booms were periods of full employment and real-wage improvement (Tables 9-11). In short, to ignore demand forces in explaining the behavior in the relative prices of men and skills is to miss the key mechanism driving the American distribution of wage income. Indeed, without the demand-mix mechanism, we are going to be very hard pressed to explain similar surges in skill differentials in the 1920s, when European immigration all but ceased.[29]

The demand-mix argument can be made clearer by reference to Figure 4. The figure can be viewed as describing short-term movements in a boom phase of a long swing or a "medium term" expansion like the 1816-1856 epic surge. The labor supply functions by skill are drawn to capture the assertion that, in the short or medium term, unskilled labor supply was considerably more elastic. It also captures the relatively

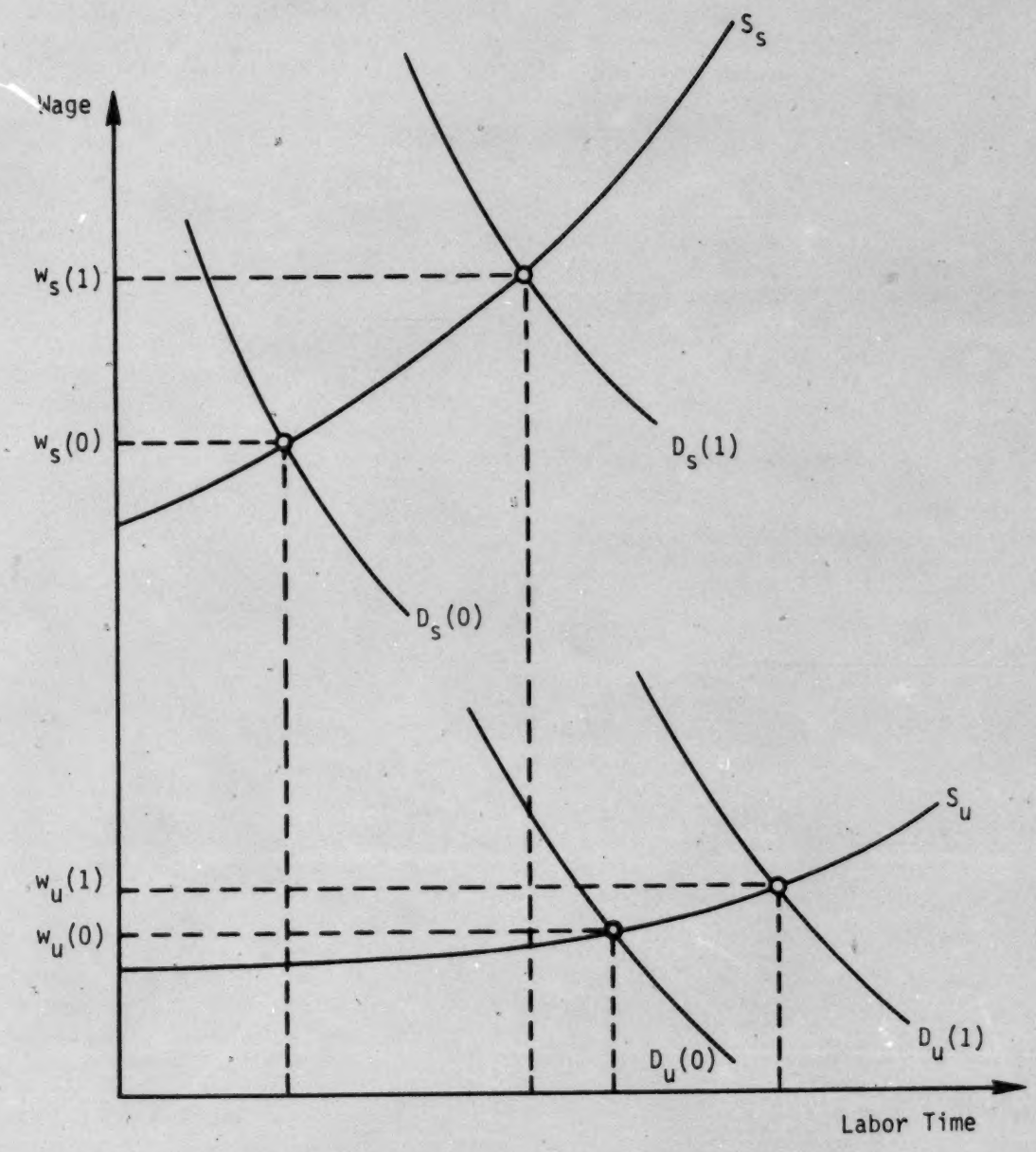


Figure 4. Changing Wage Structure in Response to Unbalanced Demand Expansion

more rapid expansion in the demand for skilled labor as nonfarm and capital formation activities undergo relatively favored growth. Wage differentials would widen even if labor supply elasticities were identical. The relatively more elastic supply of unskilled (immigrant) labor serves only to reinforce these demand forces.

Quantitative teeth can be put into these plausible assertions, but the calculations that follow must be viewed as tentative. Since the late antebellum period has always been characterized as an extraordinary phase of American structural change, it should occasion no surprise that we lay great stress on the factor market disequilibrium that such demand-mix changes must have induced. Gallman's data show that agriculture declined as a share in total commodity output from 72 to 56 percent between 1839 and 1859; manufacturing rose from 17 to 32 percent over the same two decades; mining, quarrying, and construction combined rose from 11 to 12 percent (Table 8). Now nineteenth-century agriculture was obviously far more intensive in unskilled labor than was manufacturing or construction. One excellent way to summarize factor intensity is to examine "cost shares" by industrial sector. Those sectors in which unskilled-wage payments loom large as a share of total value added are clearly activities that utilize unskilled labor very intensively. During periods of unbalanced sectoral output growth, which favor industrial activities with low unskilled-labor requirements, the economy-wide demand for unskilled labor diminishes compared to the demand for skills and machines. Increasing skill premiums and income inequality are observed as a result.

Define the economy-wide unskilled-labor share as

$$\theta_U = \frac{w_U L_U}{V},$$

where the numerator is simply aggregate wage payments to unskilled workers and V is aggregate value added. The unskilled-labor share can be written as a weighted average of the sectoral shares, θ_{Uj}:

$$\theta_U = \sum_j \theta_{Uj} v_j,$$

where the v_j are the sectoral value-added shares in GNP and $\sum_j v_j = 1$. Holding these θ_{Uj} constant, we could examine the predicted impact of the changing antebellum output mix on the economy-wide unskilled-labor share:

$$\Delta\hat{\theta}_U = \sum_j \theta_{Uj}(\Delta v_j), \text{ where } \sum_j \Delta v_j = 0.$$

The results might suggest some useful inferences on the role demand may have played in generating a declining unskilled-labor share, a rising skill premium, and increasing urban inequality during the antebellum period. Unfortunately, antebellum (or even late nineteenth-century) data are not available to document empirically our qualitative knowledge of sectoral factor intensity. In 1921, however, the share of unskilled wages in value added was[30]

jth sector	θ_{Uj}
agriculture	.527
mining and quarrying	.187
manufacturing	.268
construction	.184

No doubt the comparable figures for 1849 or 1859, were they available, would be somewhat higher. Yet it seems unlikely that the relative magnitudes sector by sector could have been very much different, and that is all we require for the calculation reported below.

Suppose we were to apply these 1921 θs to the antebellum sectoral value-added data. Holding these θ_{Uj} constant, what should have been the impact of unbalanced growth on the unskilled-labor share from 1839 to 1859? The answers appear in Table 8, and they bear remarkable similarity to wage structure trends during the period. First, the calculation predicts a decline of 5 percent in θ_U over the twenty years.[31] We shall argue below that this is a minimum estimate of the trend toward inequality induced by the changing relative demand for unskilled labor. Second, we note that the most impressive decline in θ_U takes place in 1844-1849, a period of five years that encompasses an "epic surge" in wage differentials. The decline continues up to 1854, replicating historical wage structure indices as well. Third, the half decades 1839-1844 and 1854-1859 register the mildest predicted declines in θ_U. They seem to correspond rather closely with the documented skill premium (Figure 3).

There is reason to believe that the calculations reported in Table 8 seriously underestimate the impact of demand on distribution. There are two reasons for this suspicion. First, we have seen that the relative price of unskilled labor declined sharply from 1839 to 1859. On these grounds, the θ_{Uj} themselves certainly must have diminished over time as well. Obviously one initiating source of the declining θ_{Uj} was the shift in output away from unskilled-labor-intensive goods. A full general equilibrium model would be essential to untangle this

Table 8

Illustrative Calculation of the Impact of Changing Output Mix on Unskilled Labor's Share: 1839-1859

Year	Value Added (1879 prices):				Total Commodity Output (1879 prices)	Unskilled Labor's Share Using 1921 θ_{Uj}	$\hat{\Delta\theta}_{Uj}$
	Agr.	Min.	Mfg.	Const.			
1839	787	7	190	110	1094	.445	--
1844	944	14	290	126	1374	.437	-.008
1849	989	17	488	163	1657	.413	-.024
1854	1316	26	677	298	2317	.404	-.009
1859	1492	33	859	302	2686	.401	-.003

Source: Output data in millions of 1879 dollars from R. E. Gallman, "Commodity Output, 1839-1899," in Trends in the American Economy in the Nineteenth Century (New York: National Bureau of Economic Research, 1960), Table A-1, p. 43, using Variant A. The underlying θ_{Uj} are from Williamson, "War, Immigration and Technology," Table A-2. See text.

interdependence, but one thing is clear: Table 8 underestimates the impact of output-mix changes on the relative price of unskilled labor and inequality statistics. There is a second and perhaps more important reason to suspect an understatement. Data limitations make it impossible to expand the commodity output analysis to include services. The service sector (transportation, personal services, wholesale and retail trade) was a very large share of urban employment then, as now. Obviously, nonfarm value-added shares were rising far more rapidly during this period of extraordinary urbanization and structural change than was the share of manufacturing and construction in commodity output. If the θ_{Uj} for services tended to be lower than that for agriculture, then we have additional grounds for believing that Table 8 grossly understates the role of demand. In 1972, at least, services (excluding domestics, a residual employment activity) had far lower unskilled-labor content.[32]

In short, there is a presumption that the lion's share of the inequality surge during the antebellum period was attributable to sharply changing relative factor demand conditions favoring skills and machines at the expense of unskilled labor. These demand conditions created a disequilibrium in rates of return, which the economy could only begin to eliminate when the additional disequilibrating conditions introduced by the Civil War had dissipated, say in the period 1874-1896. The question then becomes: What was the source of these abrupt output-mix changes in the antebellum and the post-Civil War "catching up" period? What are the elements of industrialization that seem to guarantee a widening in pay differentials whether immigration is present or not?

The sources were the conventional ones: (i) rapid rates of physical capital accumulation which required factory and social overhead construction, but an even more dramatic expansion in producer durable goods production--activities that use heavy doses of machines and skills; (ii) unbalanced sectoral rates of technological change that favored manufactured commodity-producing sectors--activities that use heavy doses of machines and skills; (iii) tariff policy that also favored manufactures--activities that (relative to agriculture at least) use low unskilled-labor inputs. It seems to me that the explanations are likely to lie here in collaboration with immigrant-swollen "elastic" unskilled-labor supplies.[33] We shall have much more to say about this issue in section IV, where we explore the dramatic cheapening of machines, a historical process upon which so much of the distribution trends turns.

III. Real Wages and the Nominal Price of "Raw" Labor in the Long Term

This section constructs an index of the nominal price of unskilled or "raw" labor from 1816 to 1948. It also presents an index of real earnings, a series which, oddly enough, has until now been absent from our quantitative accounts of American economic progress. Given nominal unskilled wages as the numeraire, we can then describe the American input price structure over long periods of time. Our ultimate goal is to develop indices that document the long-term nineteenth-century behavior of the relative rental price of men and machines in the northeastern states. This key "price ratio" can then be used to understand America's experience with the earnings structure and the distribution of labor income.

Tables 9, 10, and 11 present, in our judgment, the best continuous wage series on unskilled, or "common," labor in the Northeast. For the earliest period, 1816-1834, we are limited--with the exception of some scattered Massachusetts agricultural wage data cited below--to Vermont farms. Adams's Vermont wage series is known to be of very high quality, but care must be taken in its use. Wage "gaps" between rural and urban areas are common empirical attributes of dynamic economies. Apart from cost of living advantages associated with rural location (an advantage estimated by Koffsky to have been from 14 to 27 percent even as late as 1941!), nominal wages for the young and unskilled tend to be higher in urban labor markets during periods of relative or absolute demise of farming activity. After all, these are precisely the wage signals that trigger the rural-urban migration necessary to meet shifting labor demands. It is, therefore, hardly surprising that urban common laborers earned more than agricultural laborers in Massachusetts from the 1770s to 1820. What is surprising, however, is the behavior of the Massachusetts wage gap over a century: In particular, it declined very sharply from the 1810s to the 1830s.[34] Evidence such as this suggests that the nominal wage presented in Table 9 overstates the rise in northeastern urban wages up to the early and mid-1830s. The brief period 1835-1839 utilizes Layer's Massachusetts cotton mill operatives data, while from 1840 to 1860 we rely on Edith Abbott's unskilled-wage series. The latter is based on the Aldrich Report and thus limited to northeastern urban employment. For the 1861-1869 period, we have rejected Long's series in favor of Abbott's. Both are taken from the Aldrich Report, but Abbott's daily wage index has broader coverage. Long's manufacturing daily wage of common labor in eastern cities, based in turn on the BLS Bulletin No. 18,

Table 9

Two Antebellum Unskilled-Earnings Indices,
Real and Nominal (1860=100), Northeastern States

	Nominal		Real	
	(1) Unskilled Mfg. Daily	(2) Unskilled Daily	(3) Unskilled Mfg. Daily	(4) Unskilled Daily
1816		72.8		
7		94.6		
8		94.6		
9		85.0		
1820		77.7		61.9
1		66.4		55.2
2		65.4		51.7
3		64.5		51.9
4		64.8		56.9
1825		65.5		56.6
6		65.5		58.2
7		65.5		57.5
8		65.5		57.6
9		65.5		57.8
1830		72.8		67.4
1		65.5		59.0
2		75.2		68.6
3		79.7		72.3
4		80.1		76.9
1835	94.8	91.0	80.8	77.6
6	98.7	94.8	72.5	69.6
7	100.3	96.3	72.7	69.8
8	92.8	89.2	69.7	67.0
9	99.7	95.7	75.7	72.7
1840	98.8	92.2	90.4	84.4
1	90.7	88.3	92.3	89.8
2	92.7	83.5	104.9	94.5
3	92.0	76.7	110.7	92.3
4	89.4	80.6	110.9	100.0
1845	91.4	82.5	111.1	100.2
6	94.8	88.3	115.8	107.8
7	96.7	88.3	97.0	88.6
8	100.3	86.4	109.6	94.4
9	98.7	90.3	107.3	98.2
1850	101.3	88.3	113.4	98.9
1	95.0	86.9	106.5	97.4
2	95.6	88.3	97.3	89.8
3	97.5	92.2	95.9	90.7
4	98.7	99.0	83.2	83.5

Table 9 (continued)

	Nominal		Real	
	(1) Unskilled Mfg. Daily	(2) Unskilled Daily	(3) Unskilled Mfg. Daily	(4) Unskilled Daily
1855	100.0	97.1	79.2	76.9
6	107.6	99.0	90.8	83.5
7	107.6	98.1	85.5	78.0
8	103.2	98.1	101.8	96.7
9	103.2	98.1	100.6	95.6
1860	100.0	100.0	100.0	100.0

Source: Column (1): 1835-1849, R. G. Layer, Earnings of Cotton Mill Operatives, 1825-1914 (Cambridge: Harvard University Press, 1955), Table 6, pp. 24-26. Data in Layer for 1825-1834 are ignored due to inconsistent sample and season. 1850-1860, E. Abbott, The Wages of Unskilled Labor in the United States, 1850-1900 (Chicago: University of Chicago Press, 1905), Table VII, p. 363. Weighted averages from Aldrich Report. Layer is preferred to Abbott from 1840-1849 since Aldrich sample is too small and inconsistent prior to 1850.

Column (2): 1816-1834, T. M. Adams, Prices Paid by Vermont Farmers, Bulletin No. 507 (February 1944), Vermont Agricultural Experiment Station (Burlington, Vt.), Table 45, pp. 87-88. 1835-1839, Layer, 1840-1860, Abbott, Table X, p. 363. Uses Aldrich Report data restricted (with the exception of Ohio) to northeastern urban employment of common or unskilled labor and weighted averages. The Abbott series includes unskilled operatives in manufacturing as a small subset.

Columns (3) and (4): Columns (1) and (2) deflated by cost of living of unskilled laborers in eastern cities, J. G. Williamson, "Prices and Urban Inequality: American Cost of Living by Socioeconomic Class, 1820-1948," EH 74-26 (Madison: University of Wisconsin, Graduate Program in Economic History, August 1974), Table A-1, p. 49.

Table 10

A Late Nineteenth-Century Unskilled-Earnings Index,
Real and Nominal (1860=100): Northeastern States

	Unskilled Daily Wage	
	(1) Nominal	(2) Real
1860	100.0	100.0
1	102.3	100.0
2	104.4	94.1
3	117.1	89.4
4	137.1	77.5
1865	152.4	81.8
6	157.4	84.5
7	156.3	89.2
8	156.5	89.3
9	164.8	100.8
1870	169.7	106.5
1	161.1	103.4
2	161.1	103.5
3	160.2	105.2
4	159.2	108.2
1875	156.3	110.6
6	155.4	115.0
7	133.3	100.2
8	126.6	102.3
9	126.6	107.0
1880	127.5	106.3
1	134.3	108.1
2	147.7	115.3
3	149.6	123.9
4	149.6	133.8
1885	148.6	136.7
6	147.7	134.4
7	147.7	134.2
8	146.7	129.1
9	145.8	127.8
1890	148.6	130.2

Sources: Column (1): 1860-1869, revises Abbott's unskilled-labor series (E. Abbott, The Wages of Unskilled Labor in the United States, 1850-1900 (Chicago: University of Chicago Press, 1905), Table X, p. 363). Abbott uses weighted averages of Aldrich Report data, including quarrymen (Table V, p. 362). The latter exhibit sufficiently bizarre behavior to warrant exclusion. The revised series does exclude them. 1870-1890, uses the BLS Bulletin 18 data for common labor in manufacturing for eastern cities, daily wage (Williamson, "The Relative Rental Price of Men, Skills and Machines: 1816-1948," revised mimeo, August 1974, Table 7, p. 32).

Table 10 (continued)

Sources: (continued)

Column (2): Column (1) deflated by unskilled workers' cost of living (urban) index. 1860-1880 from Williamson, "Prices and Urban Inequality," Table 5, p. 23. 1881-1890 uses Burgess's cost of living index (Historical Statistics, E-158, p. 127) converted to 1860 = 100.

Table 11

Unskilled-Earnings Index, Real and Nominal:
Urban, 1890-1948

	Unskilled Weekly Wage: Douglas (1914=100)		(1860=100)		Unskilled Male Weekly Mfg. Earnings (1914=100)		(1860=100)
	(1) Nominal	(2) Real	(3) Real		(4) Nominal	(5) Real	(6) Real
1890	77	84.6	130.2	1927	204	120.0	184.7
1	78	85.7	131.9	8	207	123.2	189.6
2	77	85.6	131.7	9	211	124.8	192.1
3	77	85.6	131.7	1930	190	115.9	178.4
4	76	88.4	136.0	1	167	112.5	173.1
1895	76	91.6	141.0	2	125	94.5	145.4
6	76	92.7	142.7	3	129	103.7	159.6
7	76	93.8	144.4	4	143	111.2	171.1
8	77	93.9	144.5	1935	159	120.4	185.3
9	77	93.9	144.5	6	173	129.7	199.6
1900	78	94.0	144.7	7	194	140.4	216.1
1	80	95.2	146.5	8	179	132.3	203.6
2	81	95.3	146.7	9	198	148.3	228.2
3	83	95.4	146.8	1940	207	153.8	236.7
4	84	96.6	148.7	1	244	172.6	265.6
1905	85	98.8	152.1	2	290	185.8	285.9
6	88	98.9	152.2	3	336	203.1	312.6
7	91	97.8	150.5	4	356	212.8	327.5
8	90	98.9	152.2	1945	355	208.0	320.1
9	93	102.2	157.3	6	354	191.5	294.7
1910	93	98.9	152.2	7	405	192.3	295.9
1	93	97.9	150.7	8	432	190.5	293.2
2	95	97.9	150.7				
3	99	101.0	155.4				
4	100	100.0	153.9				
1915	104	102.0	157.0				
6	114	99.1	152.5				
7	136	98.6	151.7				
8	187	112.7	173.4				
9	206	109.6	168.7				
1920	221	116.9	179.9				
1	173	103.0	158.5				
2	168	102.4	157.6				
3	190	113.1	174.1				
4	193	115.6	177.9				
1925	199	113.1	174.1				
6	201	116.2	178.8				

Table 11 (continued)

Sources: Column (1): P. Douglas, Real Wages in the United States, 1890-1926 (Boston: Houghton Mifflin, 1930), Table 59, p. 177.

Column (2): Column (1) deflated by urban unskilled cost of living index from Williamson, "Prices and Urban Inequality," Tables 7 and 9, pp. 30 and 35.

Column (4): Historical Statistics, E-665, p. 94; linked to Douglas at 1926.

Column (5): Column (4) deflated by urban unskilled cost of living index from Williamson, "Prices and Urban Inequality," Tables 9 and 11, pp. 35 and 41.

Table 12

A Skilled-Wage Index, 1816-1896
(1860=100)

Year	W_s	Year	W_s	Year	W_s
1816	47.7	1840	82.8	1865	151.0
1817	66.7	1841	79.3	1866	158.9
1818	65.2	1842	75.0	1867	163.9
1819	62.1	1843	68.9	1868	164.4
1820	56.2	1844	73.0	1869	172.3
1821	50.9	1845	76.0	1870	178.5
1822	50.2	1846	82.8	1871	170.1
1823	49.2	1847	94.4	1872	171.3
1824	49.6	1848	92.2	1873	174.0
1825	50.5	1849	90.6	1874	172.8
1826	52.6	1850	91.9	1875	168.3
1827	53.2	1851	91.8	1876	164.1
1828	54.3	1852	92.0	1877	139.0
1829	53.7	1853	95.9	1878	132.4
1830	58.8	1854	105.0	1879	128.8
1831	55.2	1855	103.7	1880	132.6
1832	63.4	1856	109.0	1881	139.7
1833	70.0	1857	98.7	1882	154.1
1834	73.1	1858	95.9	1883	153.7
1835	82.1	1859	98.1	1884	156.7
1836	84.8	1860	100.0	1885	151.7
1837	81.9	1861	103.4	1886	152.8
1838	75.2	1862	110.0	1887	151.0
1839	82.4	1863	117.7	1888	149.2
		1864	137.8	1889	148.6
				1890	151.6
				1891	156.3
				1892	152.0
				1893	152.9
				1894	152.6
				1895	151.1
				1896	151.0

Sources: Tables 6, 8, 9, and 10. See text.

is applied to the 1870-1890 period, while Paul Douglas's unskilled weekly wage index takes the series up to 1926. The NICB unskilled male weekly earnings index completes the series to 1948.

It is not our purpose here to discuss the real economic fortunes of "the great army of the unskilled" from early industrialization to the watershed of the Roaring Twenties a century later, but a brief comment seems deserved. While the "raw" real wage rose at the impressive per annum rate of 1.2 percent during the four antebellum decades, it fell far below the 2 percent rate of growth in real GDP per laborer in the nonfarm sector.[35] Furthermore, almost all of the improvement took place prior to the 1840s rather than afterward. Real wage growth in manufacturing, for example, was only 0.85 percent after 1835, 0.50 after 1840, and was negative after 1845. Obviously, the "great army of the unskilled"--native or foreign born--failed to share fully the fruits of early industrialization. The record after the Civil War is more impressive. Real wage levels recovered by 1869, and for almost three decades afterward the real unskilled wage grew at 1.3 percent annually. In contrast, note the very slow improvement in real wages during the two decades preceding 1913--a period that until Rees's recent research was thought to have recorded a deterioration in real wages. What might be less well known is the striking similarity between this episode of remarkable immigration and the earlier rush of immigrants in the two decades following 1840: Both periods recorded annual real wage rate growth of 0.50 percent. The most extraordinary growth in real wages by far, however, took place from 1926 (when wartime real wages were finally recovered) to 1948. Skipping over the Great Depression and World War II, the secular growth in real "raw" wages was 2.25 percent per annum from 1929 to the mid-forties. This is a period

when per capita GNP was growing at 1.5 percent and gross private product per man hour at 2.1 percent. It seems likely that any analytical explanation of these real wage series will go a long way toward explaining more sophisticated distribution statistics.

IV. The Relative Costs of Men and Machines: 1827-1889

Contributors to the "dear labor" literature apparently equate the market rate of interest with the firm's cost of capital. Nothing could be farther from the truth, since borrowing rates only measure the cost of external industrial finance. The secular behavior in the user costs of fixed capital, or their relative discrepancies between England and America, were more fundamentally influenced by machine (or more generally, plant and equipment) costs. Habakkuk is quite explicit on this point when discussing the transformation of the American textile industry in the nineteenth century:

> in the early phase of development the Americans... were forced to rely on American-made machines and... these were dearer than machines made in England.[36]

Even in the 1840s,

> the best English opinion...seems to have believed that where the same type of machine existed in both countries the English version was better and cheaper. James Montgomery thought this of textile machinery (with the possible exception of looms) and metal-working machines.[37]

We may have some doubts about the objectivity of early English observers of "backward" America, but even so they very quickly revised their evaluation as the century progressed:

> the rapid emergence in the 1850's and '60's of firms of specialized machine-tool builders multiplied their number, until by the 1880's...the price of American machine tools had fallen to half that of the equivalent British tools.[38]

Where do machine costs enter into an accounting of "capital costs"? If we treat machines, like labor and skills, as assets that can be rented (although apparently they rarely were), then the annual rental price on a machine is simply the product of its cost and "the" interest rate. If the machine depreciates in use, then that too must be included. Thus, the rental price of machines can be expressed as

$$C(t) = P_I(t)\{r(t) + \delta(t)\},$$

where P_I is the nominal price of the machine (of fixed quality) and r and δ are the interest and depreciation rate, respectively.[39]

Tables 13 and 14 present three such machine rental indices for nineteenth-century America. Each of these $C_j(t)$ is then related to the same nominal cost of raw labor to yield the three indices of the relative cost of machines, $C_j(t)/W(t)$, reported in Figure 5. The first utilizes Gallman's (economy-wide) implicit price index of manufacturers' durables, 1839-1893. The second is more limited, but perhaps more relevant. It uses Brady's (economy-wide) price index for <u>industrial</u> (as opposed to, say, farm) machine-shop products, 1834-1889. The third is limited to New England textiles where $P_I(t)$ is McGouldrick's machinery cost index per spindle, 1827-1886. It could be argued, of course, that none of these three machine price indices adequately controls for improving quality, the problem being most severe, presumably, earliest in the century. Since the quality of machines was surely growing at rates surpassing raw labor, it seems quite likely that the indices presented in Figure 5 understate the extent of the downward plunge in the relative rental price on machines during the nineteenth century. In any case, it

Table 13

The Relative Rental Cost of Machines:
Economy-wide Indices, 1834-1893

Year or Period	Gallman's Manufacturers' Durables			Brady's Machine-Shop Products		
	(1) $P_I(t)$	(2) C(t)	(3) C(t)/W(t)	(4) $P_I(t)$	(5) C(t)	(6) C(t)/W(t)
	1860=100		1860=100	1860=100		1860=100
1834	--	--	--	156	23.20	182.8
1836	--	--	--	162	24.24	161.3
1839	118.5	18.02	120.8	149	22.66	149.4
1844	109.1	16.19	128.7	152	22.56	176.6
1849	113.4	17.36	123.4	138	21.13	147.6
1854	105.6	15.98	103.5	115	17.40	110.9
1859	105.3	15.59	101.9	107	15.85	101.9
1869	--	--	--	113	17.37	66.5
1869-1878	88.2	13.32	55.2	--	--	--
1879	--	--	--	71	10.10	50.3
1874-1883	71.5	10.43	47.2	--	--	--
1879-1888	54.7	7.50	33.7	--	--	--
1889	--	--	--	32	4.18	18.1
1884-1893	41.9	5.47	24.0	--	--	--

Sources: Column (1) is from R. Gallman, "Gross National Product in the United States, 1834-1909," in Output, Employment, and Productivity in the United States after 1800 (New York: National Bureau of Economic Research, 1966), Table A-3, p. 34. Column (4) is from D. Brady, "Price Deflators for Final Product Estimates," in ibid., Tables 2A and 2B, pp. 110-111. $P_I(t)$ refers to constant quality industrial machine-shop products in the Brady series; it refers to the implicit price index of manufacturers' durables in the Gallman series. Brady's series represents a product group that is a subset of Gallman's. Columns (2) and (5) are calculated using the expression in the text and $\delta = 0.10$. The "interest rate," r(t), is taken from the following: 1834-1889, S. Homer, A History of Interest Rates (New Brunswick, N.J.: Rutgers University Press, 1963), Table 38, pp. 286-288 and is the yield on New England Municipal Bonds; 1884-1893, Historical Statistics, X337, p. 656, and is Cowles's railroad bond yields linked to the New England Municipal bond series. Columns (3) and (6) both take the nominal unskilled daily wage, W(t), from Tables 9, 10, and 11.

Table 14

An Index of the Relative Rental Cost of Machines in New England Textiles (1860=100): 1827-1886

Year	(1) $P_I(t)$	(2) $r(t)$	(3) $C(t)$	(4) $C(t)$ (1860=100)	(5) $\frac{C(t)}{W(t)}$ (1860=100)
1827	27.97	.0461	4.086	314.3	479.8
1828	26.82	(.0470)	3.943	303.3	463.1
1829	25.67	.0477	3.791	291.6	445.2
1830	19.93	.0490	2.970	228.5	313.9
1831	17.65	(.0495)	2.639	203.0	309.9
1832	15.38	.0500	2.307	177.5	236.0
1833	15.15	.0487	2.253	173.3	217.4
1834	14.92	.0487	2.219	170.7	213.1
1835	15.73	.0483	2.333	179.5	197.3
1836	16.32	.0496	2.441	187.8	198.1
1837	14.23	.0495	2.127	163.6	169.9
1838	14.31	.0501	2.148	165.2	185.2
1839	13.61	.0521	2.070	159.2	166.4
1840	13.49	.0507	2.033	156.4	169.6
1841	13.08	.0499	1.961	150.8	170.8
1842	12.65	.0495	1.891	145.5	174.3
1843	11.57	.0488	1.722	132.5	172.8
1844	11.88	.0484	1.763	135.6	168.2
1845	12.80	.0486	1.902	146.3	177.3
1846	12.80	.0492	1.910	146.9	166.4
1847	12.72	.0514	1.926	148.2	167.8
1848	12.72	.0531	1.947	149.8	173.4
1849	12.90	.0531	1.975	151.9	168.2
1850	11.74	.0513	1.776	136.6	154.7
1851	10.18	.0508	1.535	118.0	135.8
1852	10.58	.0498	1.585	121.9	138.1
1853	11.27	.0499	1.689	129.9	140.9
1854	12.22	.0513	1.849	142.2	143.6
1855	12.08	.0516	1.831	140.8	145.0
1856	11.13	.0510	1.681	129.3	130.6
1857	11.47	.0519	1.742	134.0	136.6
1858	9.34	.0503	1.404	108.0	110.1
1859	9.22	.0481	1.365	105.0	107.0

Table 14 (continued)

Year	(1) $P_I(t)$	(2) r(t)	(3) C(t)	(4) C(t) (1860=100)	(5) $\frac{C(t)}{W(t)}$ (1860=100)
1860	8.79	.0479	1.300	100.0	100.0
1861	8.88	.0504	1.336	102.8	100.5
1862	9.93	.0491	1.481	113.9	109.1
1863	12.22	.0437	1.756	135.1	115.4
1864	15.47	.0480	2.290	176.2	128.5
1865	15.38	.0551	2.385	183.5	120.4
1866	14.68	.0550	2.275	175.0	111.2
1867	13.80	.0534	2.117	162.8	104.2
1868	13.54	.0528	2.069	159.2	101.7
1869	12.92	.0537	1.986	152.8	92.7
1870	12.39	.0544	1.913	147.2	86.7
1871	11.14	.0532	1.707	131.3	81.5
1872	14.83	.0536	2.278	175.2	108.8
1873	13.80	.0558	2.150	165.4	103.2
1874	11.50	.0547	1.779	136.8	85.9
1875	9.38	.0507	1.414	108.8	69.6
1876	9.05	.0459	1.320	101.5	65.3
1877	9.72	.0445	1.405	108.1	81.1
1878	9.43	.0434	1.352	104.0	82.1
1879	9.02	.0422	1.283	98.7	78.0
1880	10.27	.0402	1.440	110.8	86.9
1881	12.29	.0370	1.684	129.5	96.4
1882	11.88	.0362	1.618	124.5	84.2
1883	11.25	.0363	1.533	117.9	78.8
1884	10.50	.0362	1.430	110.0	73.5
1885	9.77	.0352	1.321	101.6	68.4
1886	9.58	.0337	1.281	98.5	66.7

Sources: Column (1) is from P. McGouldrick, New England Textiles in the Nineteenth Century (Cambridge: Harvard University Press, 1968), Table 46, pp. 240-241 and refers to machinery cost per spindle in the Baker sample of New England firms. Column (2) is taken from the same source cited in Table 13, while Columns (3) and (5) are calculated as in Table 13.

Averages referred to in the text are the following:

1827-1829	462.7
1840-1849	170.9
1858-1861	104.4
1880-1886	79.3

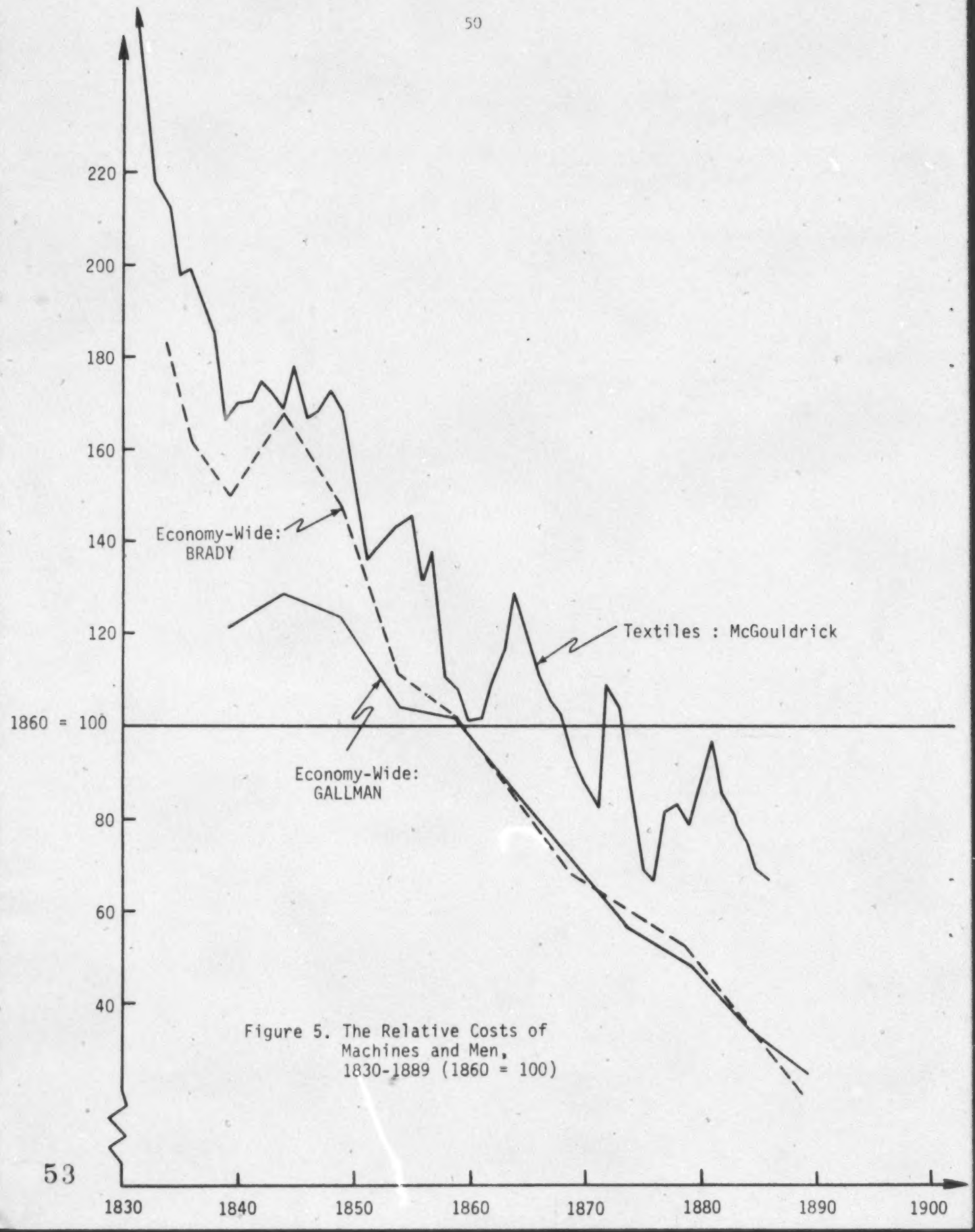


Figure 5. The Relative Costs of Machines and Men, 1830-1889 (1860 = 100)

is comforting that the economy-wide and the textile indices move closely together in the long term and over the "long swing," although the textile index underwent the steeper decline during the antebellum period.

Now then, how did the rent on machines behave during the nineteenth century compared with men and skills? If we wish to learn more about factor scarcity, technique choice, and factor-saving biases in nineteenth-century industrialization, such comparisons are surely relevant.[40] Is Habakkuk's characterization of "machine costs" correct? How does the extraordinary surge in the relative "rent" on skills up to the 1870s compare with the relative rent on machines? The answers can be found in Figure 5. There seem to have been three epic slides in the relative cost of machines, but the intensity of each appears to have diminished as the nineteenth century wore on. First, from the late 1820s to 1840s, the ratio of machine to raw labor rents for textiles and industrial machine shop products fell at incredible annual rates: 6.5 percent for textiles alone. Second, from the 1840s to the eve of the Civil War, the rental ratio in textiles declined by 3.1 percent per annum, half the decline of the previous period but still extraordinary. The Brady economy-wide figure (1844-1859) is 3.7 percent, while Gallman's index declines by 1.6 percent over the same period. All of these computed rates are underestimates: If twentieth-century experience were to be our guide, the economy-wide figure would be more like 4.2 percent per ann[41]. The rate of decline in textiles following 1860 and the Civil War slows down still further: 1.2 percent up to the 1880s. The economy-wide rate is considerably higher, 4.5 percent, from 1859 to the 1880s.

Suppose "machine costs" were treated as the exogenous force that initiated this episodic slide in relative input costs. Could the

exogenous change in the quality and price of machines have been responsible for the shifts in the derived demand for factor inputs described in Section II? What impact would such forces have had on the labor market, wages, the wage structure, and income distribution? Recent research on the contemporary American economy has confirmed that skilled labor and capital are complements,[42] at least in nonfarm activities. Under these conditions, a diminution in the relative cost of machines should have had three effects in nineteenth-century America, and all three should have produced a disequilibrium in the labor market through derived factor demand effects. First, the rate of capital formation, especially "machine accumulation," should have risen.[43] Since direct and indirect (metal working) capital formation activities are relatively skill intensive, the relative demand for, and thus the rent on, skills should have risen. Second, those sectors utilizing machines more extensively should have been favored. That is, manufacturing would have been favored at the expense of agriculture, and indeed, rapid "industrialization" is an attribute of the antebellum period upon which we all agree. Since agriculture used skilled labor least intensively in the nineteenth century, the relative demand for skills should have risen on that score too. Third, everywhere in the American economy farms and firms should have made efforts to substitute the cheapening factor, machines, for <u>all</u> other factors <u>except</u> skills--since the latter are assumed to be complementary to capital--thus raising the relative demand for skills. Given the enormous decline in the rent on machines compared to the rent on men from the 1820s to the 1880s,[44] it is no wonder that the premium on skills rose as a result over the same time period.

The change in relative "factor scarcities" over these three decades was indeed revolutionary. While the 1830s economy may be characterized by cheap skills and expensive machines, the 1870s or even 1860s surely would be characterized by expensive skills and cheap machines. But our quantitative wandering through nineteenth-century input "prices" suggests two questions of more fundamental importance to the macroeconomic historian. First, what exogenous forces might be responsible for the initial decline in the relative cost of machines? The answer must lie primarily with unbalanced rates of total factor productivity growth--very rapid in the producer durables sector--but nineteenth-century tariff and tax policies tended to lower the relative price of producer durables too.[45] Second, why does the skill premium, and thus earnings inequality, persist for the fifty or sixty years following the Civil War? What role does immigration play in accounting for this long lag?

V. The Structure of Wages: 1890-1948

While the literature on nineteenth-century earnings distribution and wage structure is very slim, that for the twentieth century is just the opposite.[46] The contributors to the literature on wage structure seem to be in blissful academic agreement. First, the wage structure tended to collapse from the turn of the century to the post-World War II era. Furthermore, most of the narrowing took place from the late 1930s to the end of World War II, a result that conforms to Kuznets's documentation of an "income revolution" centered on the same dates.[47] Second, the literature seems to agree that, with the exception of war booms, rapid growth and full employment tended to cause a spread in the wage structure.

Third, the literature concludes that, with the important exception of the 1930s, depressions tend to cause a narrowing in the wage structure. Both of these cyclical attributes were found for the nineteenth century in earlier parts of this paper.[48] Fourth, wars tend to produce a narrowing in wage differentials.

This section does no serious damage to the positions summarized above. Yet, the discussion of twentieth-century dynamics of the wage structure suffers from some deficiencies. It fails to relate the more recent experience to nineteenth-century labor market forces. For example, it might be of some interest to determine whether the "postrevolutionary" 1948 level in wage differentials simply recovered late nineteenth-century labor market conditions or whether it terminated a "grand traverse"[49] initiated by early industrialization following 1816. Similarly, we need to know more about American wage structure experience from 1896 to World War I. Is it a period of rising differentials, and if so, when does the skill differential--and presumably earnings inequality--reach its peak? The literature sheds no light on these and related issues for two reasons: (i) it commonly compares post-World War II with 1907 benchmarks; (ii) it utilizes for annual observations a very limited and inadequate series on union rates in the building trades first published by Ober and since reproduced uncritically.

Our new index of skilled-wage differentials is presented in Table 15 and Figure 6. In contrast to conventional twentieth-century accounts, four aspects of these trends in pay differentials are worth emphasizing at length. First, 1896 is a turning point for earnings differentials in much the same fashion that it is a turning point for so many other long-run economic indicators.[50] After two decades of stable or declining pay

Table 15

A Skilled-Wage Ratio Index: 1890-1948
(percent)

Year	Linked Series	Year	Linked Series
1890	170.2	1920	180.6
1891	173.2	1921	190.4
1892	170.6	1922	194.3
1893	171.7	1923	191.7
1894	173.5	1924	193.3
1895	171.8	1925	195.2
1896	171.7	1926	195.3
1897	179.7	1927	192.2
1898	180.1	1928	191.9
1899	182.5	1929	189.3
1900	182.5	1930	192.2
1901	182.9	1931	190.3
1902	180.9	1932	195.1
1903	182.6	1933	191.2
1904	187.8	1934	186.5
1905	185.7	1935	188.0
1906	184.6	1936	191.7
1907	184.9	1937	189.3
1908	187.9	1938	190.1
1909	190.9	1939	188.8
1910	191.9		
1911	194.9		
1912	196.0		
1913	196.0	1948	177.3
1914	198.9		
1915	198.9		
1916	198.9		
1917	187.6		
1918	176.4		
1919	172.2		

Sources: 1890-1903: C. D. Wright, "Wages and Hours of Labor," Nineteenth Annual Report of the Commissioner of Labor (1904), Table IIIC. Linked at 1890 to Table 5. The index is specific to North Atlantic urban areas. It is an unweighted average of the building trades and ten manufacturing industries: brick, flour, foundry and machine shops, glass, iron and steel bar, iron and steel open hearth, lumber, marble and stone, planing mills, and printing and publishing.

Table 15 (continued)

Sources: (continued)

1904-1907: Bureau of Labor Bulletins No. 65 (July 1906), Table I, and No. 77 (July 1908), Table II. Changing definitions and samples make it possible to link this computed series to the 1890-1903 index only by restricting the industry observations to the following: building trades, foundry and machine shops, iron and steel bar, marble and stone, planing mills, and printing and publishing.

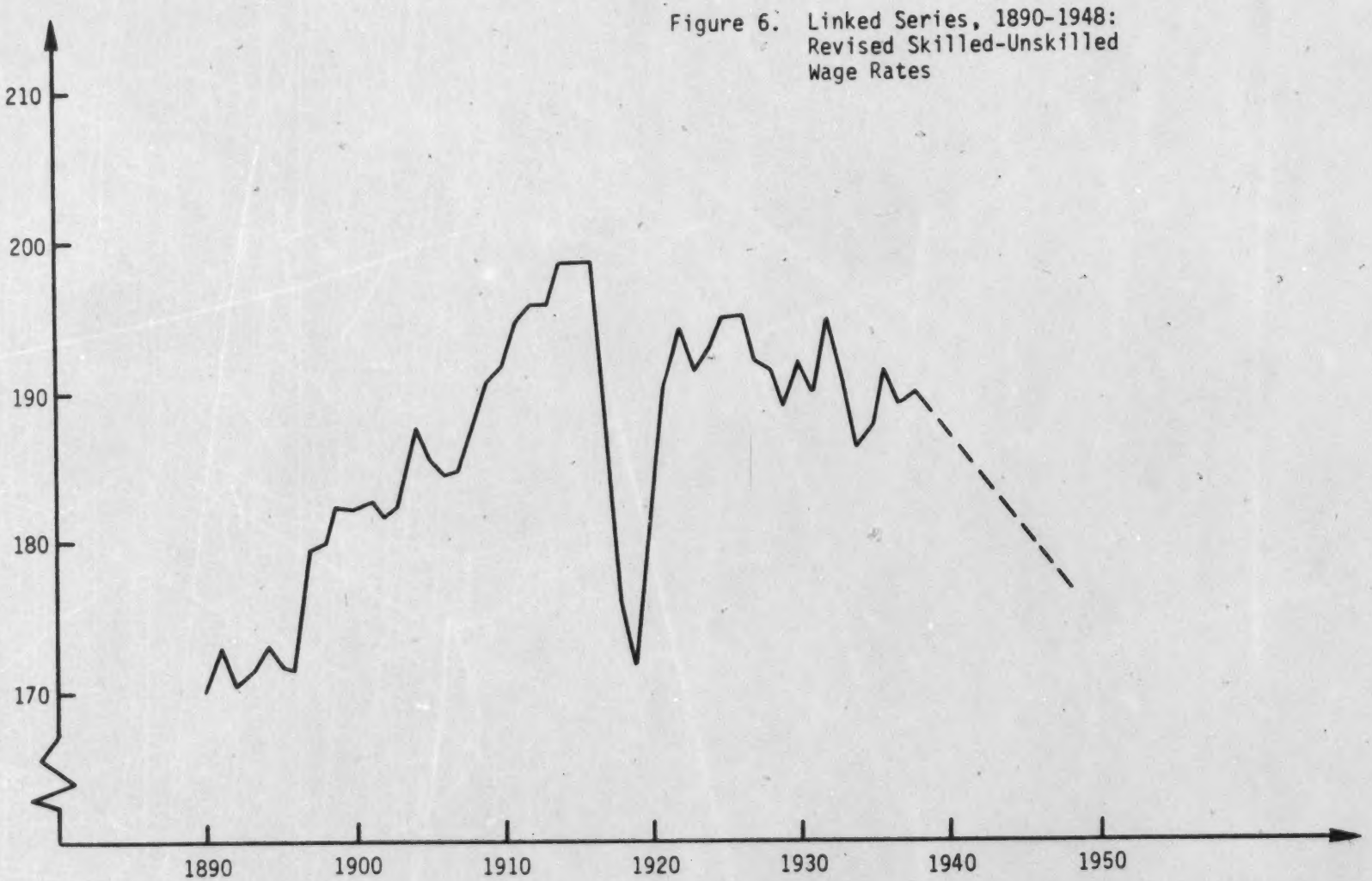
1907-1914: There is no alternative, to our knowledge, but to use the OBER-BLS union building trades series. H. Ober, "Occupational Wage Differentials, 1907-1947," Monthly Labor Review 67 (August 1948), Table 3, p. 130, linked on 1907.

1914-1920: The NICB reports one observation for manufacturing in 1914 before presenting a continuous series for 1920 and following. The implied NICB trend 1914-1920 conforms well with other evidence. Taking a 1920 employment weighted average (S. Kuznets, National Income and Its Composition, 1919-1938 (New York: National Bureau of Economic Research, 1941), Tables M22 and C4, pp. 597, 643) of printing and publishing (W. S. Woytinsky et al., Employment and Wages in the United States (New York: Twentieth Century Fund, 1953) Appendix Table 117, p. 761, based on union rate scales) and Ober's union building trades, yields a decline from 204.6 in 1914 to 185.9 in 1920. The NICB documents an almost identical trend from 204.7 to 185.9. For intervening years, we apportion the annual movements (in percent) 1915-1919 in OBER-BLS to the missing years in the NICB series:

	NICB	OBER Building Trades
1914	204.7	198.9
1915	204.7	198.9
1916	204.7	198.9
1917	193.1	190.9
1918	181.5	182.9
1919	177.2	179.9
1920	185.9	185.9

1921-1948: The NICB manufacturing series from M. A. Beney, Wages, Hours and Employment in the United States, 1914-1936 (New York: NICB, 1936), Table 4, 54-56, and The Economic Almanac 1951-52 (New York: NICB, 1951), p. 274.

Figure 6. Linked Series, 1890-1948: Revised Skilled-Unskilled Wage Rates



differentials, the skill differential undergoes another "epic surge" almost approximating the magnitude of the 1816-1856 inequality surge some eight decades earlier. The skill differential rises at an annual rate of 0.8 percent from 1896 to 1914 and 1.3 percent from 1816 to 1856. Second, this pre-World War I surge in the wage structure is far more pronounced than the oft-noted "revolutionary" narrowing from the late thirties to 1948. As a result, the skill premium in the immediate post-World War II period was still considerably above that of the mid-1890s. Indeed, it was not very much different than that which prevailed a century earlier, in the 1850s! Third, although the World War II revolutionary narrowing has received much attention, we note that the narrowing during World War I was considerably more impressive and thus warrants greater research.[51] Finally, it appears that the "return to normalcy" in the 1920s was very different than that of the 1940s. The former has skill differentials more or less returning to prewar levels while the latter reflects a permanent transition. We need some answers to this puzzle; indeed the time is ripe to supply a tight analytical accounting of these twentieth-century historical trends.[52]

NOTES

[1]Calculated from E. H. Phelps-Brown, A Century of Pay (London: Macmillan, 1968), p. 47. This characterization was held by the vast majority of contemporary analysts. Taussig, for example, found the "comparatively low rate of pay for the unskilled" prior to World War I "markedly peculiar." F. W. Taussig, International Trade (New York, 1927), pp. 58-60.

[2]H. J. Habakkuk, American and British Technology in the Nineteenth Century (Cambridge: Cambridge University Press, 1967).

[3]N. Rosenberg, "Anglo-American Wage Differences in the 1820's," Journal of Economic History 27 (June 1967):221-229.

[4]M. W. Reder, "The Theory of Occupation Wage Differentials," American Economic Review 45 (December 1955):846-848; R. Ozanne, Wages in Practice and Theory: McCormick and International Harvester, 1860-1960 (Madison: University of Wisconsin Press, 1968), p. 145; K. Taira, "Wage Differentials in Developing Countries: A Survey of Findings," International Labour Review 93 (March 1966):281-301.

[5]Ozanne, Wages in Practice and Theory, p. 145. Further documentation of the view that skill ratios decline with development can be found in H. B. Lydall, The Structure of Earnings (Oxford: Claredon Press, 1968) and H. Gunter, "Changes in Occupational Wage Differentials," International Labour Review 89 (February 1964): 136-155.

[6]Habakkuk, American and British Technology, p. 24.

[7]Ibid, p. 126.

[8]Ibid, p. 130.

[9]Ibid., p. 21. Paul David joins Habakkuk in this "exceedingly curious exercise of explaining yet uncorroborated 'facts'" (or fictions) in his Technical Choice, Innovation, and Economic Growth (Cambridge: Cambridge University Press, 1975), p. 20. Spengler is more cautious: "...there are not yet at hand enough comparative studies...to permit assessment of the not easily isolated influence of immigration upon American wage structures." J. J. Spengler, "Effects Produced in Receiving Countries by Pre-1939 Immigration," in The Economics of International Immigration, ed. B. Thomas (New York: St. Martin's Press, 1958), p. 35.

[10]J. F. Zabler, "Further Evidence on American Wage Differentials, 1800-1830," Explorations in Economic History 10 (Fall 1972):109-117.

[11]D. R. Adams, "Wage Rates in the Early National Period: Philadelphia, 1785-1830," Journal of Economic History 28 (September 1968):404-426; "Some Evidence on English and American Wage Rates, 1790-1830," Journal of Economic History 30 (September 1970):499-520.

[12]D. R. Adams, "Wage Rates in the Iron Industry: A Comment" and J. F. Zabler, "More on Wage Rates in the Iron Industry: A Reply," Explorations in Economic History 11 (Fall 1973):89-99.

[13]Zabler states

> the mid-Atlantic region was generally more typical of the U.S. norm... than the aberrant New England region to which it is compared by Adams; Adams's data and conclusions seem more typical of the atypical New England region rather than the United States as a whole.... ("More on Wage Rates," p. 99)

[14]S. Lebergott, Manpower in Economic Growth (New York: McGraw-Hill, 1964), pp. 173-175.

[15]R. G. Layer, Earnings of Cotton Mill Operatives, 1825-1914 (Cambridge: Harvard University Press, 1955), Table 14, p. 52.

[16]C. D. Wright, Comparative Wages, Prices and Cost of Living (from Massachusetts Bureau of Statistics of Labor, 16th Annual Report, 1885) (Boston, 1889). Computations gleaned from pages 22, 54, 55, and 185.

[17]C. D. Long, Wages and Earnings in the United States 1860-1890 (Princeton: Princeton University Press, 1960).

[18]J. G. Williamson, "War, Immigration and Technology: American Distributional Experience, 1913-1929," EH74-24 (Madison: University of Wisconsin, Graduate Program in Economic History, April 1974) and "Demand and the Distribution of Income: America 1913-1929," (paper presented to the Sixth International Congress on Economic History, Copenhagen, Denmark, August 19-23, 1974).

[19]J. G. Williamson, "Late Nineteenth Century American Retardation: A Neoclassical Analysis," Journal of Economic History 33 (September 1973): 581-607.

[20]This remarkable statement was made in 1835. A. de Tocqueville, Democracy in America (New York: A. A. Knopf, 1963), p. 161. It predates by 120 years a more popular version:

> Is there a possible relation between this secular swing in income inequality and the long swing in other important components of the growth process?

S. Kuznets, "Economic Growth and Income Inequality," American Economic Review 45 (March 1955): 19.

[21]M. Bronfenbrenner, Income Distribution Theory (Chicago: Aldine, 1971), p. 16.

[22]R. Easterlin, "The American Population," in L. Davis et al., American Economic Growth: An Economist's History of the United States (New York: Harper and Row, 1972), Table 5.1, p. 123, reports the following shares of population growth explained by net immigration:

1818-1820	.028	1840-1850	.234
1820-1830	.038	1850-1860	.311
1830-1840	.117	1860-1870	.247

[23]While he is not very precise regarding the general equilibrium effects, Chiswick's theorizing and contemporary empirical analysis conform well with our view of American nineteenth-century earnings experience.

> The dynamic changes in an economy that are responsible for economic development create disequilibriums in factor markets. These disequilibriums can be translated into increases in the inequality of rates of return from investments in [human capital].... Thus, rapid economic growth is likely to be associated with an increase in the inequality of rates of return to training.

B. R. Chiswick, "Earnings Inequality and Economic Development," Quarterly Journal of Economics 85 (February 1971):30.

[24]Habakkuk, American and British Technology, p. 21. Italics added.

[25]Ibid., p. 24.

[26]J. G. Williamson, "Watersheds and Turning Points: Conjectures on the Long Term Impact of Civil War Financing," Journal of Economic History 34, no. 3 (September 1974): 636-661, and "Late Nineteenth Century Retardation."

[27]Easterlin's figures can be found in his Population, Labor Force, and Long Swings in Economic Growth: The American Experience (New York: National Bureau of Economic Research, 1968), Table A-3, p. 190. The net immigration shares in labor force growth are:

1870-1880	.212	1890-1900	.265
1880-1890	.339	1900-1910	.417

[28]Habakkuk, American and British Technology, p. 96.

[29]Quantitative support for this assertion can be found in J. G. Williamson, "The Sources of American Inequality, 1896-1948," Discussion Paper No. 260-75 (Madison: University of Wisconsin, Institute for Research on Poverty, March 1975), in which it is shown that demand forces have played a powerful role in the twentieth century.

[30]Williamson, "War, Immigration and Technology," Table A-2.

[31]In another paper, we concluded that

> if the unskilled wage share in nonfarm income was 40 percent in 1820, these growth rates imply that the share would have declined to 35 percent by 1860.... It appears that the epic surge in the skilled wage differential up to 1856 was indeed accompanied by a sharp increase in urban income inequality.

J. G. Williamson, "Prices and Urban Inequality: American Cost of Living by Socioeconomic Class, 1820-1948," EH74-26 (Madison: University of Wisconsin, Graduate Program in Economic History, August 1974), p. 11.

[32]The relevant figures for 1921 are:

jth sector	θ_{Uj}
agriculture	.527
personal services	.216
finance	.197
trade	.172
transportation and communications	.163

[33]Note that the demand-mix hypothesis helps account for the short-term Civil War episode as well. The low and declining skill premiums from 1862 to 1865 can be explained, at least in part, by the cessation of capital formation activities and the expansion of farm production in

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a fashion similar to America's twentieth-century wars. In the twentieth-century case, the issue is not so much the absolute expansion of wartime farm production but rather the sharp cessation in the peacetime rate of agriculture's relative demise. See Williamson, "War, Immigration and Technology," and "Tariffs, Capital Accumulation and Distribution," mimeo, April 1974.

[34]The data can be found in C. D. Wright, Comparative Wages, pp. 184-185. Scattered information on Massachusetts day rates are documented there for the years from 1752 to 1883, but it is best used for decade averages:

Decade Ending with:	(1) Agricultural Laborers	(2) Urban Common Laborers	(3) Relative "Wage Gap" (2) : (1)
	(1860=100)	(1860=100)	(1860=100)
1760	30.8	29.7	96.4
1770	32.7	33.3	101.8
1780	31.2	38.6	123.7
1790	39.2	43.9	112.0
1800	47.3	63.9	135.1
1810	77.1	83.8	108.7
1820	77.4	93.3	120.5
1830	79.5	81.6	102.6
1840	86.6	89.4	103.2
1850	94.1	87.4	92.9
1860	100.0	100.0	100.0
1880	129.7	151.8	117.0
1883	135.6	154.9	114.2

Similar data on wage gaps in the 1890-1929 period can be found in J. G. Williamson, "Wage Gaps, Farm Income and Rural Cost of Living: 1890-1971," mimeo, 1975.

[35]The figure refers to 1818-1860 and is taken from Williamson, "Prices and Urban Inequality," p. 10.

[36]Habakkuk, American and British Technology, p. 96.

[37]Ibid., p. 106.

[38]Ibid. The estimate comes from W. P. Strassman, Risks and Technological Innovation (Ithaca: Cornell University Press, 1959), p. 117.

[39]The firm that does not rent its machine is assumed to behave as if it does by making appropriate imputation changes. If it doesn't, it eventually loses its market to competitive firms that do. Under conditions of ownership, the expression for C(t) should include capital gains. This analytical nicety is ignored in what follows.

[40]Oddly enough, in Technical Choice, Innovation and Economic Growth, Paul David was concerned with precisely these issues, but nowhere in the book can such secular input rental data be found.

[41]Based on R. J. Gordon's estimate of producer durables' quality improvement rates in the post-World War II period. "Measurement Bias in Price Indexes for Capital Goods," Review of Income and Wealth, Ser. 17, no. 2 (June 1971):171.

[42]See, for example, E. Berndt and L. Christensen, "Testing for the Existence of a Consistent Aggregate Index of Labor Inputs," SSRI Workshop Paper No. 7317 (Madison: University of Wisconsin, Social Science Research Institute, March 1973).

[43]It certainly did. See Williamson, "Watersheds and Turning Points," in which the sharp shift in capital formation activity toward producer durables is discussed.

[44]Landes is in error when he states

> From 1870 on...the marginal productivity of improvements diminished as the cost of equipment went up and the physical advantages over existing techniques fell.

D. Landes, The Unbound Prometheus (Cambridge: Cambridge University Press, 1969), pp. 234-235. Figure 5 shows a continuous decline in the relative "cost" of equipment in the period 1870-1890. True, the decline almost disappears when we examine the "cost" of all capital (for example, including construction or plant). See also J. G. Williamson, Late Nineteenth Century American Development: A General Equilibrium History (Cambridge: Cambridge University Press, 1975), Ch. 5.

The reader will note the sharp contrast between Professor David's view of midwestern farm mechanization in the 1850s ("The Mechanization of Reaping in the Ante-Bellum Midwest," in Industrialization in Two Systems, ed. H. Rosovsky (New York: Wiley, 1966)) and my own. David believes it is the relative cost of harvest labor that diminished farm threshold size and thus induced mechanization (see, for example, pp. 216-219). I would accord the major role to cheapening reapers--especially when quality adjusted. See Williamson, "Technology, Growth and History," Journal of Political Economy (forthcoming).

[45]See Williamson, "Watersheds and Turning Points."

[46]An excellent recent survey can be found in Lydall, The Structure of Earnings, pp. 169-180 and 220-225, while a useful firm study is available in Ozanne, Wages in Practice and Theory: McCormick and International Harvester, 1860-1960. Apart from Ober's pioneering empirical study (H. Ober, "Occupational Wage Differentials, 1907-1947," Monthly Labor Review 67 (July 1948):127-134), two postwar contributions deserve special

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note: P. Bell, "Cyclical Variations and Trend in Occupational Wage Differentials in American Industry Since 1914," Review of Economics and Statistics (November 1951):329-337, and P. Keat, "Long-run Changes in Occupational Wage Structure, 1900-1956," Journal of Political Economy 68 (December 1960):584-600.

[47]S. Kuznets, Shares of Upper Income Groups in Income and Savings (New York: National Bureau of Economic Research, 1953). Arthur Burns "popularized" Kuznets's findings in "Looking Forward" in Frontiers of Economic Knowledge (New York: National Bureau of Economic Research, 1954), pp. 135 ff., and a critical counterattack followed. The subsequent criticisms by Perlo, Lampman, Solow, Orshansky, and Kolko have failed, in my judgment, to tarnish Kuznets's original findings. See Williamson, "Sources of American Inequality."

[48]The agreement is not total. Kravis, for example, states that "Skill differentials tend to widen in depression and narrow in prosperity." The confusion regarding twentieth-century experience is based, I think, on the failure to treat war-and-return-to-normalcy cycles separately. The demand-mix changes associated with such wartime cycles are very different (indeed, opposite) to those associated with peacetime cycles. The 1930s are a separate puzzle requiring independent treatment. I. Kravis, The Structure of Income (Philadelphia: University of Pennsylvania Press, 1962), p. 29.

[49]Simon Kuznets called it a "long secular swing" in his influential Presidential Address to the American Economic Association some twenty years ago. Although he was speculating on American income distribution

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experience, Kuznets hypothesized the following scenario, which seems to conform remarkably well to trends in pay differentials:

> I would place the early phase in which income inequality might have been widening...from about 1840 to 1890....I would put the narrowing of income inequality...beginning with the first world war....

S. Kuznets, "Economic Growth and Income Inequality," American Economic Review 45 (March 1955): 19.

[50]Williamson, "Late Nineteenth Century Retardation" and Late Nineteenth Century American Development, Ch. 5.

[51]Some tentative analysis along these lines can be found in Williamson, "Demand and the Distribution of Income."

[52]The first such attempt, to my knowledge, can be found in Williamson, "Sources of American Inequality."